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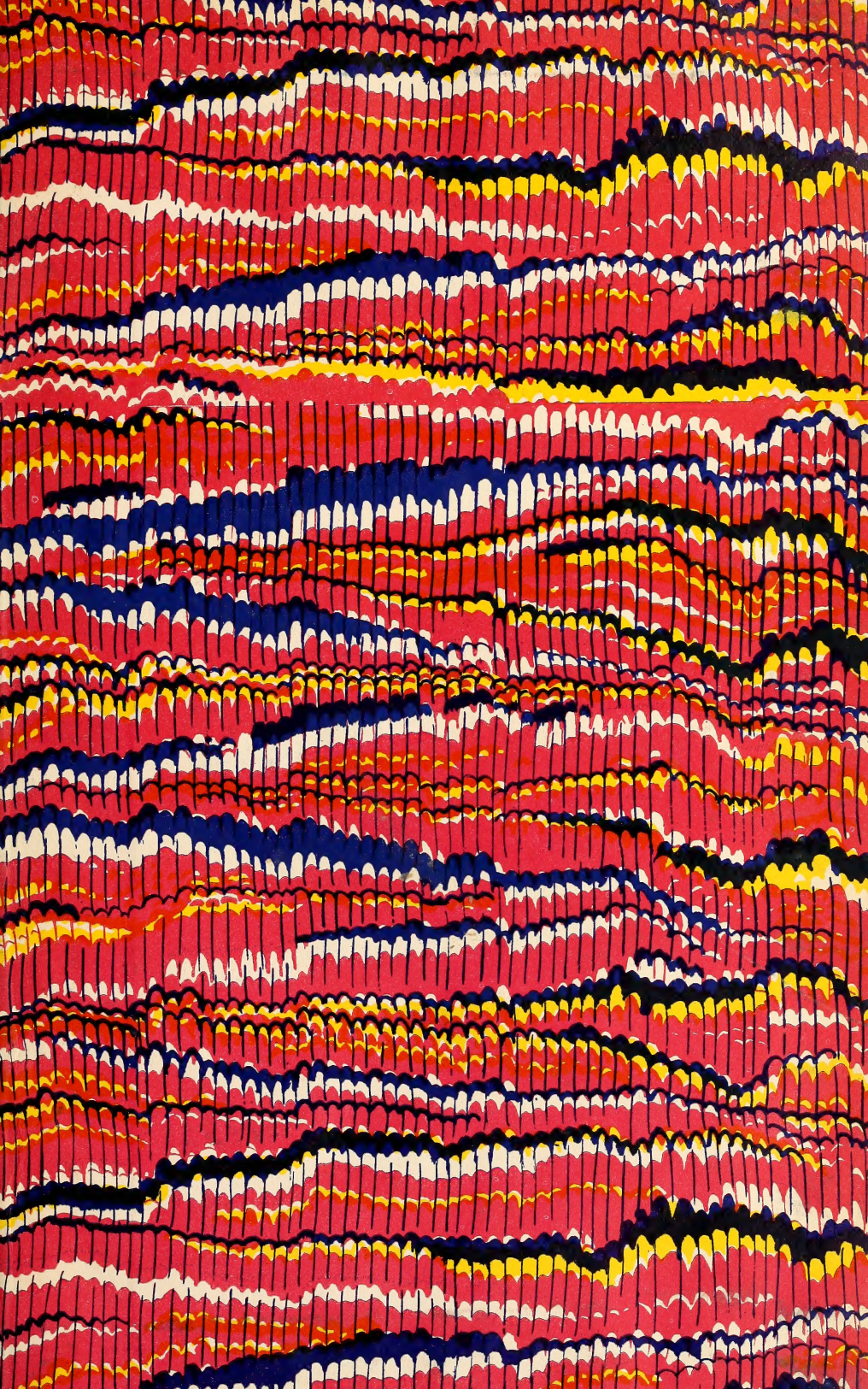

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REPORT of THE SECRETARY OF AGRICULTURE
1933

REPORT of THE SECRETARY OF AGRICULTURE

1933

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1933

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REPORT OF THE SECRETARY OF AGRICULTURE, 1933

WASHINGTON, D.C., *November 15, 1933.*

To the PRESIDENT:

THE DILEMMA OF THE SURPLUSES

In the simpler days before the war when we were a debtor Nation and foreign nations were willing to take all we could produce in satisfaction of our debt, we were not bothered by thoughts of economic planning. Production overshot demand only occasionally and temporarily. Foreign nations wanted our goods and had the means to pay for them.

The war and its consequences changed the situation utterly. With our production power vastly expanded and the foreign demand greatly curtailed, it was necessary to establish a new balance. This required adjustments in both supply and demand. Agriculture, especially, found itself in a dilemma. It could not reduce its output as rapidly as the demand declined and there was no way to increase the demand. It was involved in heavy production for a foreign market that had been forced, for lack of purchasing power, to cease, or almost to cease, buying. In these circumstances economic planning became not merely advisable but necessary. Adjusted production on the one hand and restored buying power at home and abroad on the other stood out as things absolutely indispensable to agricultural recovery.

Accordingly, the farmers of the United States are beginning to plan together under Federal guidance. Agricultural conditions have improved greatly during the last 6 months, partly because something has been done to balance production with demand and partly because Government action has improved the economic situation generally. Rising farm prices and farm incomes and the return of hope and confidence to the agricultural community are matters on which one is tempted to dwell. But it is more important to emphasize the problems that await solution.

The recent improvement is not simply a typical phase of the economic cycle or a natural turning of the tide, but a result, in large part, of deliberate policy and action. It by no means signifies that customary ways of doing things may safely be resumed. It is necessary to ponder carefully the conditions out of which the improvement developed, so that we may make it lasting.

Tremendous Price Disparity

What the depression of 1929–33 did to agriculture appears most strikingly in the tremendous disparity it produced between the prices of farm commodities and the prices of the goods that farmers usually

buy. Farm-commodity prices had dropped by early 1933 to a point 50 percent below the pre-war level, whereas in 1928 they had averaged nearly 50 percent above. Prices paid by farmers for commodities dropped down to, but not below, the pre-war level. Thus farm commodities had only half their pre-war unit-purchasing power. Gross farm income from the production of 1932 was less than half that of 1929, whereas fixed charges, including taxes and interest, were not proportionately lower. Mortgage interest and taxes together took almost 25 percent of the gross farm income. As a result of the big drop in farm prices and the comparatively small declines in farm costs, the average farmer after paying the expenses of production, interest, rent, and taxes had only about $230 left. This gave him nothing as a return on his investment and much less than common-labor pay for his labor and management.

Agriculture, in short, was very sick, and the disease from which it suffered threatened also the entire community. Ruinously low farm earnings tended to separate farm operation from farm ownership and to degrade farmers into virtual serfdom. The collapse of farm prices caused a heavy loss in farm valuations, in which farmers' equities were destroyed. All the capital employed in agriculture had a value in January 1933 of only $38,000,000,000, as compared with $58,000,000,000 in January 1929 and $79,000,000,000 in January 1919. Farmers bore the brunt of this terrific decline, because farm debt remained virtually unchanged. Average mortgage debt per acre was nearly three times greater than in the pre-war years.

Farm land values had fallen, for the country as a whole, to about three fourths of their pre-war value. Forced sales of farms had risen to new high levels. Agriculture was in fact thoroughly insolvent. Creditors could not collect their claims and became involved themselves. City people could not sell their products to farmers. The stability not merely of agriculture but also of business hung in the balance. Indeed the threat was not merely to urban business but to urban security, for social security in cities cannot long survive its disappearance in the country. The depression robbed farmers of their independence, formerly the chief attraction of country life, and thereby weakened the foundations of our whole economic system. It tended, through foreclosures and bankruptcies, to shift farm ownership from the country to the town, but under conditions that made the shift a peril rather than an advantage to the new owners.

Causes of Farm Distress

This was the situation that confronted agriculture and the Nation when the present administration took office. Some details will throw light on the causes and help to explain the relief program adopted a little later. Under the double stimulus of price and of patriotism, American agriculture during and after the war expanded tremendously its production for export. Our agricultural exports, which had generally fallen from 1898 to 1913, reached a record level in 1919. In that year we exported 15.8 percent of our farm production. Thereafter the trade declined, gradually until 1929 and then sharply. Since then the export proportion has averaged less than 7 percent of the farm production. There has been no corresponding decline

in total output, which on the contrary has increased. Here in a nutshell is much of the explanation for the agricultural depression. Declining exports with mounting production naturally mean mounting surpluses. When export surpluses cannot be profitably sold, domestic sales show a loss too; blocked export outlets force supplies back into the home market and swamp it.

It is true that the depression of 1929 caused a decline in the domestic as well as in the foreign demand for agricultural products. Industrial conditions within the United States affect our agriculture vitally. Factory employment diminished so greatly in 1930, 1931, and 1932 that the purchasing power of the urban community fell by more than half. The decline in industrial activity wiped out the per capita increase in that activity of the previous 30 years. In such circumstances farm products had necessarily to be offered at sacrifice prices. Yet the inevitable loss would unquestionably have been smaller had trade channels not been glutted with unsalable supplies intended for export.

This is evidenced by the fact that farm commodity prices declined far more than other prices. Had farm production not been overexpanded in relation to its total market, an exactly opposite tendency would have developed, because the per capita consumption of farm products declines for obvious reasons much less than that of other goods during depressions. Primarily, therefore, the distress of American agriculture from 1920 to 1929 may be attributed to the existence of unwanted export surpluses and after 1929 also to the weakness of domestic demand. The fact that other industries not similarily overexpanded suffered too indicates that agriculture would not have escaped scot free in any event; but the exceptional degree to which agriculture suffered points clearly to relative overproduction as the principal cause.

Position of Some Leading Farm Products

The position of some leading farm products shows the magnitude of the surplus problem. World carry-over of American cotton in the 1932–33 season was 13,000,000 bales—about two and a half times the normal carry-over. Yet world cotton production in 1932–33 was the smallest since 1923–24, with the exception of 1927–28. This country's contribution to the total, though yields were normal, was nearly a fourth less than that of the previous crop year. It is difficult to imagine more impressive evidence of the extent to which the capacity to produce cotton had overshot the demand. Our cotton area increased from 28,678,000 acres in 1921 to 44,616,000 acres in 1926. Above-average yields on a cotton acreage equal to that of recent years would give a production far above the world's average annual consumption of American cotton. Average yields on foreign cotton acreage will produce from 11,000,000 to 12,000,000 bales annually. Cotton acreage in foreign countries is down only slightly from the 1925–26 peak.

Before the war the cotton situation was pretty well balanced. Production was increasing both in the United States and in foreign countries, but so was the demand. War-time and post-war developments obscured the possibility that this well-balanced position might

not last. After a brief post-war slump, cotton prices soared to high levels. Growers responded by increasing their acreage, and by 1925–26 the world had nearly 87,000,000 acres in cotton. Signs then appeared that production had been overdone. World consumption of American cotton fell in 1929–30 to 13,000,000 bales, as compared with 15,000,000 bales or more in each of the 3 preceding years. Cotton consumption fell heavily in the United States. This country, as the world's largest source of cotton, found itself burdened with a crushing surplus.

Equally staggering was the wheat surplus. In the nineteenth century this country had in Europe a market for all the wheat it had to spare. We exported, mostly to Europe, no less than 227,240,000 bushels in 1898. The trade declined in the early years of the twentieth century, and by 1911 the wheat exports had dropped to 81,891,000 bushels. American farmers adjusted themselves to the change, altered their production somewhat, and continued to prosper.

The war threw our wheat industry back into high production for export. By 1920 our wheat exports had risen to 369,313,000 bushels—far above the peak reached in the nineteenth century. Other wheat-exporting countries increased their production and exports. In 1890 the United States produced about eight times as much wheat as the combined production of Canada, Argentina, and Australia. These three countries in 1928–29 produced more wheat than we did. They produced 1,076,000,000 bushels, practically three quarters of which competed with our wheat in the European market. After the war Europe restored its wheat production. It increased the yield from 1,100,000,000 bushels in 1922 to 1,500,000,000 bushels in 1932.

As a result of all these circumstances, we had, after the crisis of 1929, a wheat production far exceeding the market demand. In 7 of the last 8 years the production of wheat in the United States exceeded 800,000,000 bushels; in 2 of those years it exceeded 900,000,000 bushels. From 600,000,000 to 700,000,000 bushels went into domestic consumption. The rest had to be exported or stored. In the existing world-market situation, American net wheat exports declined inevitably. They were less than 32,300,000 bushels in 1932–33, as compared with 142,000,000 bushels in 1928–29. Our wheat carryover increased to nearly 370,000,000 bushels in 1933, or more than three times the normal. We had on hand in this country almost half a year's average production.

Similar conditions existed in the hog industry, which during the war expanded its exports of hog products by about 200 percent, or the equivalent of 10,000,000 hogs. After the war European countries restored their hog production. Our exports of hog products had trended downward since the war, though lard had not been so much affected as pork. The war-time increase had disappeared. In 1932 the exports represented the equivalent of only 5,000,000 hogs, as compared with more than 16,000,000 in 1919. American hog farmers were beset with an excess-production problem because of a severe contraction in their export outlet, just as were the wheat and cotton growers. There had been no proportionate adjustment in hog production. On the contrary, the hog farmers had continued their production almost as if the large war-time European demand still

existed. On January 1, 1933, the estimated number of hogs on farms in the United States was 60,716,000, as compared with 63,800,000 on January 1, 1919.

These examples, which have their counterpart to a lesser extent in other farm commodities that are exported in substantial amounts, demonstrate positively that the American farm problem is largely a result of a greatly reduced export market. With excessive production for export, adjustment to demand in the home market is impossible. Under that handicap, a complete industrial revival in the United States accompanied by a great increase in consumer buying power would not restore prosperity to the farmers. Export surpluses that cannot be sold become domestic surpluses; and it is a truism that prices cannot rise permanently in overstocked markets.

Our Creditor Status

Overproduction for export is not a temporary difficulty, which will tend to disappear spontaneously with the revival of industry and trade throughout the world. Our large agricultural export trade during and after the war rested on foundations too precarious to be restored. It rested mainly on credits extended by this country to the importing nations. We went into the World War owing other nations 200 million dollars annually on interest account. We came out of it with other nations owing us more than 500 million dollars annually. Other nations now owe us annually on interest account more than 1 billion dollars. They are compelled in consequence to reduce their purchases here, all the more since we do not afford them a market for their products. The struggle of the debtor countries for agricultural self-sufficiency, and their natural inclination to buy where they can sell, make it inconceivable that the foreign demand for American agricultural products will expand sufficiently in the near future to absorb our surpluses.

After the outbreak of the war, our foreign creditors sold American securities freely in the United States, thereby reimporting capital which they had previously exported. In addition, American investors loaned half a billion dollars to the allied nations. After the United States entered the war, the Federal Government made loans to European countries. The total ran to more than 10 billion dollars. This enormous outflow of funds, which continued for a time after the war, provided European nations with a greatly increased purchasing power for American products. As a result, the excess of our exports over our imports became very large. In the peak year, 1919, it amounted to about 4 billion dollars.

In short, the United States faced the necessity of receiving from the debtor countries an increasing quantity of goods and services in payment of their obligations. This result was postponed up to 1930 by further lending. But only by lending indefinitely, in ever-increasing amounts, could this country in the long run avoid importing more than it exported. Such a one-sided movement of capital and of goods cannot be permanent even in an extremely favorable world-trade situation. It is necessarily brief when depression destroys credit. Our excess of exports over imports remained larger on the average between 1924 and 1930 than before the war not only because we

loaned much capital to foreign countries but also because American tourists made large expenditures abroad and because emigrant remittances and ocean freight payments were heavy. The depression weakened all these supports of the export trade.

After the crisis of 1929 American lending to foreign countries diminished greatly. The transfer of funds from the United States to foreign countries did not, however, cease entirely. Though our investors stopped buying foreign bonds in large amounts, foreigners withdrew considerable sums which they had on deposit in American banks. Moreover, Americans transferred large amounts to Europe after the depreciation of the dollar last March. But this outflow of short-term money cannot continue indefinitely. Inevitably, therefore, our trade balance will become less favorable. Only by foreign lending on an increasing scale can the excess of exports over imports be maintained, and the chances are against that development.

Choice of Two Lines of Policy

This Nation consequently faces a choice between two lines of policy—either it must modify its tariff policy so as to permit a larger quantity and value of imports to enter the country, or it must accept a considerable and permanent loss of its foreign markets. A revival of lending, if that were possible, would postpone the necessity for making the choice but would not obviate it permanently. Manifestly the issue is of supreme importance to agriculture, which remains one of our principal exporting industries. It will probably be necessary, in any event, to count on some permanent reduction in the export demand for agricultural products; but how large the necessary reduction will be depends greatly on our tariff policy. We cannot go on selling abroad without buying abroad.

Failure to recognize such fundamental changes in debtor and creditor positions leads to political situations that complicate the supply-and-demand equation. These situations nevertheless do not override the law of supply and demand, which is remorseless in its operation. They may postpone, but cannot avert, the final reckoning. Since March 4 last the country's affairs have improved greatly. There has been a total increase in industrial pay rolls of about 65 percent, and the purchasing power of farm products has advanced materially. This improvement, however, cannot last if we do not meet the problem caused by the fact that we have at least 40 million too many acres of plow land in crops, in view of the international situation on debts, tariffs, and foreign lending.

The United States is a creditor nation with a debtor nation psychology. The American people are still essentially high-tariff in their attitude. They are disillusioned about lending money abroad and yet do not wish to allow foreign nations to send goods here to pay for our wheat and cotton and other exportable commodities. It must be one thing or the other. Either we must modify our tariff policy and perhaps also our policy with regard to international debts and foreign lending, or we must put our internal economy on substantially a nationalist basis. The best course would be to work toward an expansion of foreign purchasing power in definite, tangible ways—through tariff adjustments and eventually through

renewed foreign lending accompanied by a willingness to receive certain goods in exchange for the money loaned. The alternative course, along which we are now moving, answers the need of the emergency but demands superhuman efforts if it is to be permanent. With the foreign market practically lost, keeping down acreage and livestock production to a point that would afford a living price level to the farmers would be extremely difficult. It is necessary to balance our productive forces to the kind of world we want to live in. We have not yet decided what kind of world we want.

Emergency Adjustment Necessary

The world situation being what it is, our immediate task is to accomplish an emergency adjustment of farm production to the demand. This does not mean renouncing foreign trade. It is possible simultaneously to set about adjusting our farm production to the total demand, domestic and foreign, and to work for the removal of unnecessary impediments to international commerce. We normally export more than half our cotton, nearly half our tobacco, a fifth of our wheat, and from a third to a half of our packing-house lard. On the average we exported 13.6 percent of our agricultural products annually during the 10 years 1919–28. It is obvious that foreign trade will continue to be vitally important to American agriculture. Recognition of that fact is perfectly consistent with a determination not to offer our foreign customers vastly more than they can possibly take. If our foreign trade could be revived quickly by negotiating reciprocal tariffs and making intergovernment debt adjustments, the need for readjusting our farm production would be less urgent. It would remain nevertheless, because the production exceeds even the most optimistic estimates of the probable demand. As things now stand in the international sphere, the necessity of beginning with production adjustments is overwhelming.

To sum up the situation, American agriculture before the war stood in a satisfactory relationship to its markets, both foreign and domestic. Agricultural prices rose more than other prices. Net farm earnings increased, and also farm valuations. Farm exports declined after the beginning of the century, but growing consumption at home compensated for the decline. The war drew the United States back into tremendous production for export, while saddling the importing countries with debts and political troubles that reduced their buying power. Temporarily it created shortages of commodities both agricultural and industrial; but agriculture and industry overestimated the shortages and soon replaced them with surpluses. Tariffs excluded foreign goods which this country might have received in payment for its agricultural exports. Loans furnished our foreign customers an undependable means of payment which eventually failed. The crisis of 1929 developed largely as a consequence of these inconsistencies, though monetary difficulties in many countries played a considerable part therein. As their buying power declined, foreign countries adopted trade restrictions which added to our export difficulties, and brought world trade under governmental control to an extent unprecedented in modern times. As a result, the demand for the products of the farm dropped catastrophically, while the production remained virtually unchanged.

AGRICULTURAL ADJUSTMENT LEGISLATION

Congress provided means for dealing with the farm problem in an act (Public No. 10, 73d Congress).

to relieve the existing national economic emergency by increasing agricultural purchasing power, to raise revenue for extraordinary expenses incurred by reason of such emergency, to provide emergency relief with respect to agricultural indebtedness, to provide for the orderly liquidation of joint-stock land banks, and for other purposes.

The act, which was approved by the President on May 12, 1933, has three titles, two applying directly to agriculture, and the third to the national currency.

Title I deals with farm-production control and marketing agreements, and gives the measure its popular name—The Agricultural Adjustment Act. Title II relates to farm credits by amendments to the Federal Farm Loan Act, and by appropriations for various types of agricultural credit. Title III empowers the President to arrange for the expansion of credit by the purchase of Government securities through the Federal Reserve banks, to cause the issuance of United States notes in his discretion up to the amount of $3,000,000,000, and by proclamation to fix the weight of the gold dollar and the silver dollar. This title is called the Inflation Amendment to the Agricultural Adjustment Act and affects agriculture along with other industries by its potential influence upon the general price level.

In a declaration of policy under title I, the act says it is the purpose of Congress to establish such a balance between the production and the consumption of agricultural commodities as will restore the purchasing power of farm products "to the level of the base period." For all agricultural commodities except tobacco, the base period is the pre-war period August 1909 to July 1914. For tobacco the base period is the post-war period August 1919 to July 1929. To protect consumers, the act declares that farm production must be adjusted so as not to give the farmer a higher percentage of the consumer's total retail expenditures for agricultural commodities than he received in the base period.

Crop Adjustments and Marketing Agreements

The measure seeks to raise the incomes of farmers by two principal means: (1) By getting their cooperation in necessary crop adjustments calculated to bring supply into a better balance with demand; and (2) by authorizing the Secretary of Agriculture to enter into marketing agreements with producers, processors, and distributors of agricultural products, so that competitive wastes may be eliminated, trade practices improved, surpluses moved into markets for consumption, and producers' prices raised.

In connection with certain basic agricultural commodities, the Secretary of Agriculture may make compensatory payments to producers in return for agreements to curtail their acreage or their production for the market. The basic commodities specified are: Wheat, cotton, corn, hogs, tobacco, rice, and milk and its products. It is not mandatory for the Secretary to take this action.

He may levy taxes on the first domestic processing of any of the basic commodities, in order to raise funds for the necessary payments to farmers. The act also appropriates $100,000,000 under title I for administrative expenses and compensatory payments, and authorizes the Secretary of the Treasury to advance funds to the Secretary of Agriculture in anticipation of the proceeds of processing taxes.

Under the sections relating to marketing agreements, the Secretary of Agriculture may bring producers, processors, or handlers of farm commodities into trade relationships calculated to promote a better adjustment of supply to demand, to assure fair prices to producers, and to protect the consumer. He may license the parties concerned under regulations penalizing violations of the agreements. The antitrust laws do not apply to agreements thus made.

Farm Debt Sections of the Act

Title II of the act, originally introduced in Congress as a separate bill, contains provisions for refinancing farm indebtedness whereby excessive debts may be cut down, interest rates reduced, and payments on principal postponed. It provides means also for redeeming land which has been taken from farmers by foreclosure. Farmers whose mortgages are already held by any of the 12 Federal land banks also benefit directly by a reduction of their interest charges to 4½ percent for a period of 5 years. The measure appropriates $15,000,000, and such additional sums as may be necessary, to reimburse Federal land banks for this reduction. Federal land banks may issue bonds up to $2,000,000,000 on which the Government guarantees the interest. The act also appropriates $50,000,000 which the Secretary of the Treasury may use in subscribing to the paid-in surplus of the Federal land banks. The orderly liquidation of joint-stock land banks is provided for, and a fund of $100,000,000 is made available for loans to assist in this process. A loan fund of $25,000,000 is also made available to these same banks to enable them to postpone foreclosures on delinquent loans. It authorizes and directs the Reconstruction Finance Corporation to make $200,000,000 available to the Farm Loan Commissioner for direct loans on farm real estate, and to lend up to $50,000,000 to agricultural improvement districts such as irrigation and drainage and levee districts. In addition, it permits the Reconstruction Finance Corporation to advance not more than $5,000,000, on the request of the Secretary of the Interior, to complete authorized reclamation projects.

The National Industrial Recovery Act (Public No. 67, 73d Cong., approved June 16, 1933) authorizes the President to allocate not more than $100,000,000 of the $3,300,000,000 appropriated by that act for expenditures under titles I and II of the Agricultural Adjustment Act.

Methods Provided for Crop Reduction

The law, in title I, attacks the problem of the surplus. Ordinarily the producers would attend to the matter themselves, but circumstances prevent that. Often there is no escape from the farm, except into the ranks of the unemployed; and low prices compel competing producers to maintain the volume of their output. Farm produc-

tion in the United States has not changed much since 1924, though the demand has fallen greatly. The only remedy is concerted action under central guidance, a course provided for in the law by several methods, which include the leasing of land, the payment of cash compensation in return for output reductions, the cotton-option plan, and trade agreements to regulate production and prices.

These methods will be discussed in more detail in connection with the action taken under the law regarding wheat, cotton, tobacco, dairy products, etc., but an important feature common to them all should be emphasized here—they reach the individual farmer. Agricultural production in this country results from the decisions and actions of individual farmers, and farm production ultimately determines relative farm prices. It is therefore impossible to control the output except through the individual producer, by means that insure his cooperation through a balancing of inducements with responsibilities. Cash benefits under the law go only to the farmers that join in the effort to control production.

Along with the crop-reduction programs the act authorizes efforts to obtain for farmers a larger share of the consumer's dollar. Trade groups have an incentive to cooperate. Part of the consumer's dollar goes now to support wasteful and unnecessary competition, duplication of selling expense, a needless multiplicity of so-called services to consumers, dubious credit arrangements, and various unethical practices. Eliminating these wastes should mean better conditions for honest and efficient business, as well as better prices for producers. Giving farm commodities generally a purchasing power (an exchange value) in terms of other goods, equal to that which they had before the war, may in some cases involve higher prices to consumers. Fair exchange prices, however, should not work a hardship upon anyone; in fact they should benefit the community as a whole by improving the farm market for city goods and creating city jobs. For years now consumers have had farm products at less than cost. This is not good business even for the consumer. It threatens ultimately to dry up the sources of supply. Everyone has an interest in paying the farmers fair prices, in putting agriculture back on its feet.

The consumer has a right to expect, however, that the addition to his food bill shall go to the farmer, and to no one else. Generally other interests are not entitled to any part of the increase, because they have not suffered proportionately with the farmer in the slump since 1929. In order that the consumer may know that he is really helping agriculture when he pays a little more for milk or bread or cotton goods, the Agricultural Adjustment Administration will publish facts about spreads between consumers' and producers' prices.

Action by Farmers Indispensable

Agriculture's immediate prospects depend, of course, on many things besides what may be done under the Agricultural Adjustment Act. As the Industrial Recovery Act puts men to work, it will improve the domestic market for farm products. World wheat conditions may be helped by international action to reduce wheat acreage and to remove trade barriers. Cotton demand abroad may improve

as the depression lifts. Our own administration's financial policy may raise the price level. Benefits that come to agriculture aside from its own efforts, however, may be temporary unless supported by thoroughgoing readjustments within the agricultural industry itself.

Production and marketing conditions for the different agricultural commodities vary greatly. Continuous change in economic situations makes any inflexible solution certain to be found unsuitable or ineffective after a comparatively short time. To deal with the many factors that contribute to the farmers' present situation, to deal with these factors as they apply to the commodities concerned, and to meet changes in the economic situation, the legislation grants broad and flexible powers. As already indicated, there is authority to provide for effective yet voluntary reduction in crop acreage, and to provide for a reduction in the amount of any commodity produced for market.

Briefly, the act is a program for economic planning—the first of its kind in the Nation's history. It contemplates the organization of producers for action which they cannot take individually, but which is necessary to substitute order for chaos in the agricultural industry.

The law seeks to build a regulated and properly balanced agricultural industry, with the forces of production bridled so as not to run rapidly beyond the demand, and to increase the demand by redistributing purchasing power so that it will come more readily into the market for consumable goods. It is a colossal job on lines not yet clearly defined. Broadly, the problem is to balance the agricultural industry internally and externally—internally by adjustment among its numerous enterprises, and externally by reducing total production and increasing consumer buying power.

Relation of Agriculture to Industry

In the post-war boom urban industry prospered much more than agriculture. It had a protected home market, whereas agriculture, with an overexpanded plant, had to meet world competition. In consequence nonagricultural prices rose much higher than agricultural prices after the first post-war slump. The disparity gave urban industry a temporary advantage. It could get raw materials cheap from the farm and had no need to advance wages equally with profits because living costs were low. In 1929 the rate of return on nonagricultural capital was about two and one half times the rate earned on agricultural capital. Even during the ensuing depression nonagricultural capital continued to earn on the average a bare return. Agriculture went heavily in the red.

The fact that urban industry prospered while agriculture did not gave rise to the notion that industry and agriculture had parted company, that the city could forge ahead independently, and that the old rule as to the identity of interest between the town and the country no longer applied. This was evidently a profound mistake. Industry and agriculture had not parted company. They never can do so. They had simply got out of step, while remaining harnessed together. When agriculture stumbled and fell, industry stopped with

a jerk. It became clear that industry, by taking the products of agriculture at less than cost, had injured itself. If industry gets farm supplies for too little money, it loses agriculture as a market. The loss outweighs the gain. Farmers constitute an important part of industry's market, which sags heavily when farmers are not in it. Permanent prosperity requires a fair exchange between the country and the town, not an unfair temporary advantage. It requires a balanced economy.

FARMERS AND NATIONAL RECOVERY PLANS

As part of the general recovery program the Federal Government has undertaken to raise the general level of prices through the control of credit and currency and through industrial codes designed to raise wages, increase employment, and improve labor conditions. These policies obviously affect the prices of the goods that farmers buy as well as the prices of the goods they sell. Raising the general price level decreases the burden of farm debts and taxes but does not necessarily give better relative prices for farm products. It is not a cure for all kinds of price disparity.

Steps that have been taken to raise commodity prices so that "those who have borrowed money will, on the average, be able to repay that money in the same kind of dollar which they borrowed" constitute an essential part of the national recovery program. Farmers have perhaps more interest than any other group in the restoration of the honest dollar. Controlled inflation now tends simply to correct the bad consequences of the uncontrolled deflation that followed the war. It is a means of promoting social justice through a fairer distribution of the national income. It lightens each farmer's debt and tax burden in proportion to the extent that it raises the prices of his products.

Monetary Action Alone Insufficient

Agriculture cannot, however, depend exclusively on a monetary policy to restore farm incomes. Depreciation of the dollar acts unequally on different agricultural products, as we have seen this year. It raises the prices of the export or speculative commodities such as wheat, cotton, and corn much more than it does the prices of milk, hogs, beef cattle, poultry, and other nonspeculative commodities sold mainly in the domestic market. Moreover, it also raises the prices of the things that farmers buy. Permanent farm relief has two principal requirements: (1) A rise in the general price level so that the burden of debt and taxes will be lightened, and (2) a closing of the gap between agricultural and nonagricultural prices. Only the first requirement can be confidently expected from controlled inflation.

If the general price level rises through monetary influences, without a proportionate change in production, supplies, and consumption, all prices and not merely prices to farmers respond eventually, though perhaps not uniformly. The disparity persists on a higher general price level. It is impossible for the Government, in its monetary policy, to single out any particular group of prices for special attention. By itself monetary action does nothing to change

maladjusted situations for the better. Indeed, it may tend to prevent a favorable change by temporarily hiding the need. Inflation is not a cure-all. When it stopped, as sooner or later it would, we should again discover that the agricultural problem is one of balancing production with demand. It is of great importance that rising prices generally should not cause farmers to forget that favorable price relationships cannot exist in overstocked markets.

The proper handling of our money will help us reach a true state of balance, but there are certain fundamental factors which must be handled otherwise. To control these factors in the world of today with its multitude of trade barriers requires for the time a production control which is obnoxious to every class in our society. The farmer instinctively dislikes it; the railroads and commission men are against it, because it reduces the volume of their business; processors dislike it because of the processing tax; and consumers dislike it because it increases their cost of living. But the facts of the situation bear witness to the urgent necessity of curtailing farm production.

Effect of Codes on Price Disparity

Industrial codes under the National Recovery program had results that disappointed farmers at first. In many industries wages per hour rose as much as 50 percent. Manufacturers naturally sought to pass the increase on to consumers, including, of course, the farmers. As a result, prices paid by farmers for certain commodities rose sharply. Between March and October the average advance was more than 17 percent. Farm wages also advanced, following the advance in urban wages. Agriculture did not make the progress expected in reducing the disparity between agricultural and nonagricultural prices.

It is not likely that the immediate effect of the National Recovery program foreshadows its ultimate effect. We cannot judge what is essentially a long-time program from its initial results. The raising of wages and the shortening of hours in industrial employment delays correction of the disparity between farm and nonfarm prices, but this should be only temporary. Industries that have increased their costs through higher wages and shorter hours will soon be adjusted to the new level of costs. The prices of their goods will be adjusted to it similarly, and should advance less rapidly or become stabilized. Agricultural prices on the other hand should continue to advance with adjustments in farm production and increases in consumer buying power.

It would be wrong to attribute the whole advance in nonagricultural prices to the intended and legitimate influence of industrial codes under the National Recovery Act. There has been some tendency for manufacturers and business groups to pyramid increased costs in consumers' prices. Many commodities are selling today at prices much higher than would be necessary to meet the expense involved in raising wages and shortening hours. It is an essential part of the National Recovery program that consumer buying power shall increase more than consumers' prices. Agriculture will suffer in proportion as this fails to come about. Recovery requires a bal-

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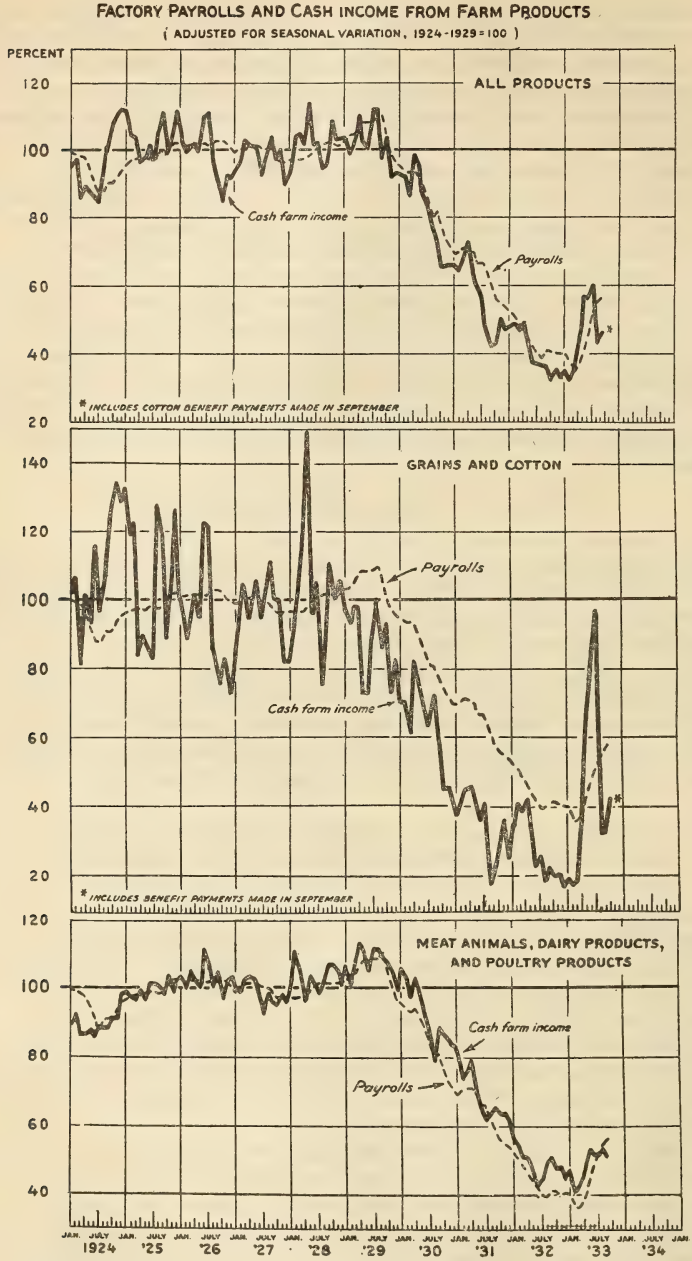

FIGURE 1.—Factory pay rolls and cash income from farm products. (Adjusted for seasonal variation, 1924–29=100.) Farm income rose much faster than factory pay rolls during the first half of 1933 but failed to retain that gain in the second half of the year. The early advance resulted largely from a sharp rise in the returns from grains and cotton. These commodities obeyed world market influences, and were particularly subject to the influence of the depreciated value of the American dollar in foreign exchange. The returns from livestock and livestock products followed more closely the course of the purchasing power of domestic consumers. There is generally a close correlation between factory pay rolls and cash income from farm products.

anced and approximately simultaneous gain in wage payments, consumer buying power, and farm prices. Keeping the recovery factors marching abreast is, however, an extremely difficult task.

Eventually the National Recovery Act should raise the prices of some of the things that farmers sell even more than it raises the prices of the things they buy through its effect on consumer demand. It should strengthen the market notably for products domestically consumed. Products largely exported will, of course, remain subject to world influence. The National Recovery program harmonizes with the agricultural program to the extent that it increases total pay rolls, and to the extent that these pay rolls are spent for farm products. Restoring urban buying through increased employment, even if nonagricultural prices rise somewhat in consequence, is an essential part of farm relief. City workers must have increased incomes in order to pay more for agricultural goods. They will do so as soon as they are able, provided farmers do not continue oversupplying urban markets.

COORDINATING THE A.A.A. AND THE N.R.A.

It became necessary, after the enactment of the National Recovery Act, to coordinate work under the two laws. An Executive order on June 26 facilitated matters. The order delegated to the Secretary of Agriculture certain powers conferred on the President by the National Recovery Act. It placed under the Agricultural Administration all industries and trades engaged principally in handling milk and milk products, tobacco and tobacco products, and foods and foodstuffs. It covered all the powers conferred by the National Recovery Act over these industries, except the determination of labor questions. The situation thus being clarified, the Agricultural Adjustment Administration promoted various marketing agreements affecting agricultural commodities and accepted for consideration certain codes of fair competition proposed by the industries and trades mentioned in the Executive order of June 26.

Marketing agreements under the Agricultural Act have certain points in common with codes of fair competition under the National Recovery Act. Both laws authorize the licensing of everyone concerned, and both provide for the regulation of marketing. There are, however, certain important differences between the provisions of the two laws. Under the agricultural law, marketing agreements may raise prices to farmers and may give full exemptions from the antitrust laws to all persons that comply with the terms. Certain provisions in the National Recovery Act might hamper the Agricultural Adjustment Administration's aims. For example, the National Recovery Act declares that no one may be prevented from marketing the produce of his farm and that codes shall not permit monopolistic practices. Furthermore the Agricultural Act extends to farmers whereas the National Recovery Act does not. Farmers cannot be parties to a code under the National Recovery Act. Marketing agreements reached under the Agricultural Act, plus codes of fair competion established in conformity with the requirements of the industrial law, may therefore include agricultural as well as industrial groups and may regulate production with the specific object of rais-

ing prices to farmers. The Agricultural Act, in short, is in some respects the broader measure.

Agreements Plus Codes

Many possibilities for combining marketing agreements under the Agricultural Act with codes under the National Recovery Act developed from the transfer of code authority over food industries to the Agricultural Adjustment Administration. It should be possible to apportion the resulting benefits with approximate equity. Marketing agreements buttressed by codes have legal advantages which marketing agreements alone would not have. Such arrangements permit of rigid checks on the spreads between producers' and consumers' prices and of a scrutiny of operating costs, other charges, dividend policy, trade and group practices, marketing operations, price policies, and accounts. Agreements plus codes may coordinate the principal and the supplementary units within an industry. They may deal with the problem of competing units within an industry and with problems arising between that industry and related industries. They may take into consideration the relationship between particular agricultural industries and nonagricultural interests. Into the vast perspectives thus opened, it is difficult as yet to see very far. Certain general principles indicate the main policies which the Agricultural Adjustment Administration will necessarily follow.

It is of primary importance that marketing agreements or codes under the Agricultural Act shall tend to raise the prices received by farmers. This end may be sought through marketing agreements with or without licenses, or through marketing agreements supplemented by codes. There are some food industries which the Executive order of June 26 placed under the Agricultural Adjustment Administration and which have nothing to do with agriculture, as for example, the fish industry. In the case of such industries, the Agricultural Administration will merely perform a function for the National Recovery Administration. In all other cases it will treat the problem of regulation as inseparable from that of increasing the earnings of agriculture. It will probably be necessary in most cases to operate by agreements under the Agricultural Act, with codes under the National Recovery Act as a supplement, because it is only the Agricultural Act that authorizes the direct raising of prices to producers.

Farm incomes may be increased through marketing agreements in two principal ways, (1) by the direct raising of prices, and (2) by awarding to farmers some of the savings that food trades and industries may make through the lifting of the antitrust laws. It is manifest that profits thus created by the authority of a measure expressly designed to benefit agriculture should not remain exclusively with nonfarm groups. On the other hand the diversion to agriculture of all the savings thus realized would deprive the nonfarm groups of all motive to cooperate in promoting the object of the agricultural law. The matter is essentially one of agreement. It is a question of pooling and fairly distributing the economic gains that the law makes possible. This can best be accomplished through marketing agreements under the Agricultural Act.

Horizontal Agreements Desirable

It seems desirable, wherever possible, to have horizontal agreements or codes covering all the industrial units involved, rather than separate agreements or codes for small units in an industry. Industrial coordination and market balance cannot well be promoted without a close articulation of related trades. Vertical agreements or codes throughout the line of processing seem desirable also. Flour millers, wheat-starch manufacturers, and bakers, for example, should be brought under a single agreement or code. This is necessary for both economic and administrative reasons. Separate agreements or codes for minute fractions of a food industry mean continuous and complicated readjustment of conflicting interests.

In some industries a general agreement or code is impossible. In such cases the next best thing is administrative centralization, such as has been undertaken in the dairy industry.

Arrangements concerning prices may take various forms in marketing agreements or codes. In certain cases, as in the milk agreements, prices both to producers and consumers may be established, with provision for periodic change. In other cases agreements may establish prices for producers and first processors or dealers. This has been done in the California peach agreement. In other cases agreements may regulate prices indirectly, through the allocation of supplies to shippers and the fixing of shippers' charges. Invariably it is necessary to consider supply and demand conditions. Prices fixed too high tend to stimulate production while restricting consumption and thus defeat the object in view. Agreements may also regulate trade practices so that unfair competition may be checked and wastes of various kinds eliminated. Agreements should promote efficiency in marketing, including processing and distribution, in order to insure the possibility either of higher prices or of returning to the farmer a larger share of the consumer's dollar.

Various expedients will advance the general objects of the marketing-agreement program. These include the collection and publication of facts about supply and demand, margins, and profits; the licensing of processors, distributors, and others; and the measurement of the savings that result from agreements. The agricultural act recognizes the interests of both the producers and the consumers. It contemplates raising the purchasing power of farm commodities to the pre-war level while protecting the consumer against extortion. It is obviously necessary to have methods of measuring and distributing the savings that result from marketing agreements. The development of the necessary accounting methods is a difficult matter and will take time. It must be done, however, because otherwise the benefits will inevitably drift into the wrong channels.

Price Regulation

Efforts to raise the prices of farm products by crop adjustments or marketing agreements should be distinguished clearly from attempts at price fixing. In certain of the adjustment programs launched this year, the administration included provisions for regulating prices. It did so in numerous milk agreements, and in agreements covering certain fruits. In all these cases, however, the price

regulations went along with efforts to adjust production. It is necessary always to consider the effect of a given price level on both production and consumption. There are always high-cost and low-cost producers. In the absence of production control, prices high enough to maintain output on the high-cost farms stimulate output excessively on the medium- and low-cost farms. Meantime, such prices tend to restrict consumption. This is why price fixing alone always fails.

Commodity Credit Corporation

On September 22 the Administration adopted a loaning plan to assure farmers a return of 10 cents a pound for the unsold balance of the 1933 cotton crop. It established a Commodity Credit Corporation, with power to advance to any cotton grower 10 cents a pound without liability to him, provided he agreed to participate in the 1934 acreage-reduction program. Growers who participated in the 1933 reduction program received close to a parity return for their cotton; the loaning plan assures all growers a minimum return per pound and an opportunity to benefit from such gains as may result from higher prices to be brought about by the acreage curtailment for 1934. A similar plan was adopted for corn following the development of a corn-hog production-adjustment program. In States where corn may be stored under seal on the farm, with warehouse receipts as collateral, corn growers may obtain an advance of 50 cents a bushel Chicago basis, provided they agree to reduce their acreage in 1934.

In everything it has done, the Agricultural Adjustment Administration has kept in view the necessity of supporting prices by supply adjustments. It has not attempted so-called "price stabilization" by storing, for the sufficient reason that removing a portion of the supply temporarily from the market without preventing a rush of new production simply makes a bad matter worse. There is no magic by which prices can be fixed arbitrarily in complete defiance of the law of supply and demand.

FARM RELIEF AND THE CONSUMER

It is the declared policy of the Agricultural Adjustment Act to protect consumers as well as to raise the incomes of the farmers. While these objects seem contradictory, actually they go well together and indeed are interdependent. The law seeks to raise not merely the prices but also the purchasing power of farm commodities. Obviously this cannot be done if the prices farmers have to pay for various commodities advance excessively.

Farmers are consumers as well as producers; they make up at least 30 percent of the consuming public and have a common interest with consumers generally in getting goods at fair prices. They buy processed agricultural materials such as dairy products, hog products, cigarettes, and cotton goods. These things in their finished form include many elements of cost that do not figure in the raw materials. The intervening costs often greatly exceed the value of the raw materials. It is extremely important that false costs should not be added to true costs.

Farmers cannot be separated from other consumers and given special protection. All consumers must have protection. The farm recovery program includes protection for the consumer, not simply as a matter of justice to the general public, but as an aid to farm relief. Failure to keep consumers' prices in a sound relationship to producers' prices would prevent farm-commodity purchasing power from rising and would defeat the objects of the Agricultural Act.

Farm recovery requires, in short, that producers' prices shall rise more than consumers' prices—in other words, that spreads between country and city prices shall be reduced. These spreads are generally wider now than they were before 1929, and universally wider than before the war. Manufacturing and distribution took a steadily increasing share of the consumer's dollar between 1910 and 1929. In the case of milk the share increased from 56 to 62 percent; in the case of bread, from 74 to 81 percent. On the average the retail prices of foods increased nearly 70 percent during this period, whereas the farm prices of foods increased only 36 percent. After 1929 farm prices dropped much more than retail prices. The spread between the country and the town prices increased proportionately.

Redistribution of purchasing power to wage earners and crop adjustments in agriculture cannot be relied on exclusively to correct the trouble. These factors should help to bring supply and demand more nearly into balance. Processors, distributors, and others, however, hold a strong position in the economic system. They can continue to exact an undue share of the consumer's dollar, if nothing is done to stop them. Codes and marketing agreements, unless very carefully drawn, may serve to perpetuate unbalanced conditions. In seeking the cooperation of processors and distributors in arrangements to pay increased prices to farmers, the administration must allow these groups a profit. It is extremely difficult not to be drawn beyond that point.

Regulation of Margins

Restoration of a good balance in the economic system may require more than allowing fair prices to farmers without charging the consumers prices exceeding the fair exchange value prescribed in the Agricultural Act. Some pending agreements that do that nevertheless permit increased profits to processors and distributors. Such increases generally would obviously work against the purposes of the Agricultural Act and the National Recovery Act and would counteract the desired redistribution of purchasing power. Regulation of production and of producers' prices would seem to require, as a logical corollary, the regulation of profits. When profits increase greatly out of proportion to wage payments, consumption inevitably falls. Farm returns fall in consequence. It is necessary to arrange matters so that processors and others who, under marketing agreements and licenses, are required to pay increased prices to farmers shall not add more than that increase in their prices to consumers. Usually they can well afford to add less.

This question of profits goes, of course, beyond the industries that handle agricultural products. Stability in our industrial as well as in our agricultural life may depend on answering it correctly. It

may be necessary to review very critically the influence of excessive profits on our economic life. Farmers know well that sharply rising farm prices produce expansion which shortly brings prices down. Similarly, unbalanced expansion results in industry from temporarily high profits, so that the profits eventually are wiped out. In both agriculture and industry a better total return would probably result, in the long run, from prices and profits that fluctuated less. One gain would be a drop in speculation, which thrives on instability. It is not high prices or high profits that cause speculation, but changing prices and profits. Methods that prevented undue fluctuations would be more powerful than many laws in curbing speculation. But more important than the prevention of speculation is the distribution of income in such a manner as to close and not widen the gap between production and consumption. Excessive margins between producers' and consumers' prices tend perhaps as much as anything else to destroy the balance.

FARMERS AND UNEMPLOYMENT RELIEF

Farm relief through unemployment relief became part of the national policy in September with the organization of the Federal Surplus Relief Corporation. This governmental agency, in cooperation with the Agricultural Adjustment Administration, purchases surplus agricultural commodities for distribution to the unemployed and their families. It transfers surplus foods and other farm products directly to needy people, in such a way as to increase the farmers' net return. Agriculture's difficulties result in part from production in excess of consumers' needs and in part from underconsumption. Low farm prices partly reflect the curtailed demand of the unemployed. By diverting excess supplies to those who cannot buy, the Government helps farmers to get better prices from those who can buy.

Funds are available to the Federal Surplus Relief Corporation from congressional appropriations and from loans from the Reconstruction Finance Corporation. Proceeds of processing taxes levied on farm products under the agricultural act may partly finance the operation where it appears that the resulting improvement of the farmers' market, through the reduction of surpluses, will justify such action. For some products farmers will obtain better returns after a portion of the supply has been diverted. They will get more for what remains for disposal through the usual commercial channels than they can possibly obtain with these channels glutted. There may be some commodities that would not respond in that way to the diversion of supplies from commercial to charitable uses. In such cases the Administration would not be justified in attempting to finance the operation through processing taxes, but it could properly use funds available from other sources.

This policy strikes at the cruel paradox of want in the midst of plenty. Farmers particularly are conscious of this paradox. They approve the distribution of surpluses to the needy and merely ask that the Nation as a whole shall bear the cost. In periods of great overproduction in agriculture, the farmers themselves carry most of the burden of relieving distress. They do it through the harsh neces-

sity that compels them to part with their entire production at less than cost. Practically, they give away much of what they produce. Hence the new relief program serves agriculture in two equally important ways. It partly frees farmers from a continual unfair drain upon their diminished resources and satisfies their feeling that people should not be allowed to starve when granaries and warehouses are bursting.

PERMANENT CONTROL OF AGRICULTURAL PRODUCTION

The present program for readjusting productive acreage to market requirements is admittedly but a temporary method of dealing with an emergency. It could not be relied on as a permanent means of keeping farm production in line with market requirements. From a national standpoint it has the disadvantage that it takes out of production both the efficient and the inefficient areas. Moreover, it carries no insurance against the expansion of production through bringing new lands into cultivation under the stimulation of the better prices achieved by curtailing production in areas now cultivated. With separate programs of control for different products, it is difficult, without severely restrictive measures, to avoid the shifting from one controlled product to other products. The need of annual campaigns for acreage reduction and of the various measures to prevent evasion involves complicated and expensive administration.

A temporary and varying reduction in the productive acreage seriously disturbs the farm economy; it may modify established rotations and feeding practices; it requires readjustments in the relationships of landlords and tenants, which may be disadvantageous to the tenants; and it necessitates the disuse or less effective use of the labor, machinery, work stock, and the equipment acquired to farm larger acreages. Overhead costs frequently cannot be curtailed in proportion to the reduction in farm operations.

Generally it must cost more to induce farmers to keep a portion of their farms temporarily idle than it would cost to rent a corresponding acreage by taking over entire farms. This may not be the case where the aim is to reduce the acreage in a single crop, in sections where that crop is but a small proportion of the total productive acreage in the farm. If, however, the aim is to reduce the farm plant as a whole, in order to deal with a tendency toward surplus production in the principal staple crop and livestock products, it will generally be less expensive and more economical even in such areas to acquire entire farms.

This conclusion may be illustrated by the situation in 14 hard winter wheat counties of Kansas, in which wheat occupies over four fifths of the land in harvested crops. Under the present recovery plan the cost of reducing the wheat acreage by 15 percent is between 17 and 36 percent of what it would cost to buy the farms outright and six times as much as owners leasing for the very liberal rent of one third of the gross production would get from their share of the wheat priced at 50 cents on the farm.

Relative Cost of Leasing and Buying

In the long run, it would be cheaper for the Government to purchase farms than to lease them. For one thing, the rate of interest that the Government pays for money is considerably less than the percentage of rental value of farms to the capital value. In 1932 for the United States, exclusive of the Cotton Belt, cash rentals of farms less taxes averaged between 6 and 6½ percent of the value of the farm real estate. In the Cotton Belt the average was higher but was complicated by special conditions of risk and responsibility. In the North Central States, where in general there has always been a tendency toward a comparatively low ratio of net rentals to values, the ratio in 1932 ranged by States from 4.33 to 6.09, averaging a little over 5 percent for the 12 States. Furthermore, the Government purchase of farms would give greater permanence of control of particular areas and a greater possibility of developing a consistent and stable policy of utilization.

This comparison of the relative cost of acquiring entire farms and of subsidizing acreage reduction within operated farms does not necessarily mean that it would be desirable to purchase immediately an area of farm land corresponding in total productivity to the area removed from cultivation under the present emergency program. That would avoid one difficulty but would create another. While reducing the farm surplus, it would increase the labor surplus. The emergency program for reducing farm production is dictated partly by the existence of huge surpluses gradually accumulated. When these surpluses diminish, less restriction of production will be necessary. Restriction will become still less necessary as the domestic demand for farm products revives.

But our farm plant will probably continue to be too large for commercial production. The economic conditions and restrictive policies that have curtailed the European demand and the subnormal domestic demand may not change for the better quickly. It is therefore necessary to consider gradually reducing and controlling the size of the farm plant as a whole as a means of supplementing and in some measure displacing the emergency policies. This can be accomplished by removing from cultivation the farms which are economically and socially least desirable, such farms as are loosely termed "submarginal."

Advantages of Eliminating Lean Acres

Eliminating the lean rather than the fat acres is desirable for many reasons besides that of reducing production. Generally, the cultivated areas most subject to water or wind erosion are those which would also be classed as poor, frequently as a result of previous erosion. In many cases, under present conditions the individual farmer cannot do what is necessary to check erosion. In certain parts of the country there are poor lands in use which may be regarded as "nuisance" areas from the standpoint of the community. These include lands that serve as breeding grounds for insect pests and plant diseases and isolated farm units within national forests. Such isolated farms sometimes enhance the fire hazard and compli-

cate problems of administration. In some areas the natural resources are so ill-adapted to farming that the standard of living remains at a poverty level. These areas depend from time to time on governmental seed loans or relief funds.

Poor schools and roads usually characterize areas of poor farm land, though sometimes more prosperous sections contribute to the school and road funds of the poor districts. In other cases the provision of schools and roads has involved the assumption of a local tax burden tolerable only in prosperous times. In many such areas during the depression there has been a serious breakdown of the local fiscal system, aggravated by tax delinquency, farm abandonment, and the passing of forest resources. A program for gradually removing poor farming areas from cultivation appears desirable to correct many economic and social maladjustments of both local and national significance, as well as for bringing our farm plant to manageable proportions.

In line with this principle is an agreement between this Department and the Public Works Administration, which provides that, for every acre of new land brought into cultivation through reclamation by public works' funds, money shall be made available to take out of cultivation an area of poor farm lands of corresponding productivity. In general the acreage of poor farm land thus removable will amount to several times the area of newly reclaimed land. Funds will be made available for studies to determine the areas that should be removed from cultivation.

In this work the Department will have in mind not only a reduction of the farm plant but also the other considerations above mentioned. It will consider the institutional and fiscal readjustments which the withdrawal of land from cultivation will involve. Land socially and economically unsuited for farming may be considered for purchase by the appropriate public agency for use as public forests, parks, or regulated grazing districts.

Federal and State Cooperation

Land-use planning vitally concerns State and local agencies as well as the Federal Government and should be developed in close cooperation with such agencies. It is important to keep poor new land out of cultivation. Short of public purchase, the main practicable method is through State policies of grants-in-aid and the exercise of the zoning power. These and other considerations emphasize the importance of Federal cooperation with State and local authorities.

When there is much unemployment, it is not always advisable to remove families even from poor land, where they may at least get food, shelter, and fuel. But many families are stranded on poor land and would welcome opportunities for favorable relocation. Recovery from the depression will open opportunities in industry for some now living under bad conditions in the country.

But the problem of farm people stranded on land too poor to furnish a decent living represents but one phase of the problem with which economic planning must reckon. In our eastern coal fields at least 200,000 miners are permanently displaced, through the

mechanization, exhaustion, or closing of the mines. There are said to be 5,000 stranded copper miners in Arizona and 15,000 oil-field workers stranded in the Southwest. There are many lumber towns in the State of Washington left to a precarious struggle through the removal of the timber.

Many of these workers came originally from the farm. Industry and the cities formerly provided an outlet for thousands of rural young people annually. In 1880, 71 percent of the population of the United States was classed as rural, in 1930 but 44 percent.

Industrialization and the rush to the cities may have gone too far. We may be entering a prolonged period of urban unemployment. Older workers have difficulty in retaining the jobs for which they were trained. A miner is said to be through at 45. Many industrial and commercial concerns draw the employment line at about 45 to 50. But such men should not be thrown on the scrap heap. There are many kinds of work which they can do for wages, at least on a part-time basis. The younger workers face the shorter work day and work week. How much unemployment is technological and how extensive unemployment from this cause will be in the future, we cannot tell. In the long run the men displaced by machinery may be needed to make the machines that displace them. But meanwhile they must eat.

Underlying both urban unemployment and agricultural distress is the need of fundamental readjustment to a changed condition. The subsistence problem is not confined to the cities. One out of seven rural families now receives relief. These people, urban and rural, should have a chance for self-help, a chance to become self-supporting.

Congress attacked the problem in section 208 of the National Recovery Act. This section provided $25,000,000 to redistribute population through loans or other aids to the purchase of subsistence homesteads. Thousands of city people, unable to get work, have struck out for themselves and gone back to the land. But a wholesale and blind movement is hazardous, both to the participants and to agriculture and rural communities. It is necessary to guide and direct the return to the soil, as well as to aid it financially, a task which has been entrusted to the Department of the Interior.

In the program to carry out the purpose of section 208 emphasis will be placed on experiments in aiding workingmen to establish garden homes within commuting distance of factory and office, so as to provide them with shelter and an opportunity to raise much of their own food, and at the same time permit them and the members of their family to work in industry and trade. Such a movement "halfway back" to the land has already gone on for a number of years in New England. The automobile, the modern highway, and the electric power line facilitate it. It provides a measure of security in times of unemployment. It should not injure the commercial farmer by seriously adding to the surplus of our agricultural staples. Indeed it may aid him by giving the worker security and stabilizing urban purchasing power.

The program may also encourage the decentralization of those industries that are economically adapted to small units located in the smaller towns and villages. Centralization in huge plants appears

to have gone too far. Moreover, this country imports many products that could advantageously be manufactured here in small plants. Plans for redistributing population should include the relocation of farmers now stranded on hopelessly poor land. This should be done in connection with a program for retiring such lands from cultivation. In the past such badly located farm people continually drifted to the cities.

If much urban unemployment should persist for a long time, farm policy may be required to provide for the thousands of young people who annually leave even good farms for the cities. The annual increase in the Nation's population now depends mainly on the natural increase of the farm population. This averages about a half million a year. For a decade preceding the present depression, the resulting annual surplus of farm people was drained away into other employment. Failing reopening of this outlet, steps must be taken to provide means whereby the half million farm people who each year reach working age may earn a living. It may be necessary to modify our former ideal of a highly efficient commercial agriculture, and to facilitate so-called "subsistence farming." Such farming would have less commercialism but a greater degree of economic stability than now prevails in many farming areas. Such a policy, as well as all policies to aid in placing more people on the land, would have to avoid as much as possible intensifying agricultural competition.

SCIENCE IN PRODUCTION AND IN DISTRIBUTION

In these efforts to balance production with demand, and to prevent useless farm expansion, it may seem that the farmer has a quarrel with science; for science increases his productivity and thus tends to increase the burden of the surplus.

Some farmers take this view. They believe we got into the present economic jam partly as a result of technical efficiency. They ask why Government agencies help farmers to grow two blades of grass where one grew before and simultaneously urge them to cut down their production. They declare it is almost criminally negligent for a Government to promote an increase of production, without facing the results of that increase. These ideas lead to something of a revolt against science, and to demands for a halt in technical progress until consumption catches up with production.

It is undeniable that science creates problems; but the remedy is not less but more of the disturbing ferment. What we need is not less science in production, but more science in distribution, and this means distribution of wealth as well as of the physical products.

Science has magnificently enabled mankind to conquer the problem of producing enough to go around. It has now to help us utilize the increased productivity.

This is the special province of economics. It is a difficult field, because the data include facts of psychology, of politics, of history, of race, and even of religion, as well as of production and demand. Reducing such diverse facts to order is harder than discovering relationships among chemical elements isolated in a test tube. The economist cannot fix his material; he must deal with the living, changing, dynamic world. But the difficulty does not excuse evading the problem. It cannot be evaded.

Gain in Farm Productivity

In agriculture, science has increased tremendously the productivity of the farm operator, without giving him equal help in disposing of the result. Note a few cardinal facts. Our total crop acreage showed no increase in the decade from 1919 to 1929. This was the first decade in our history that recorded no expansion. The number of horses, cattle, and hogs on farms declined somewhat, and there was a decrease also in the number of farms and in the farm population.

Yet the farm output, instead of declining, increased amazingly. It rose about 20 percent, whereas the country's population increased only 16 percent. In consequence our people, during the first half of the decade at any rate, lived better than ever before. They consumed about a fifth more milk per person, a sixth more pork, and probably a fifth more fresh vegetables and fruits, but less corn, rye, and wheat bread. The increased farm production, since it took place in a declining market, impoverished agriculture.

The wheat farmer in the Great Plains has at his command in the tractor and the combine the power of 300 men. He can cultivate 1,000 acres and feed 2,000 people. The corn grower has new inbred strains of corn developed in this Department and in the State experiment stations which give promise of producing the Nation's present supply of corn on 90,000,000 acres instead of 100,000,000. By fertilizing only to a profitable extent, and by a more general practice of efficient crop rotations, it would be possible to get the present corn supply from 70,000,000 acres. Moreover, this saving of land would save half a billion hours of man labor annually and would save from erosion hilly land which is now washing into the rivers.

Cotton-picking machines now being used in Texas and Mississippi seem likely to be perfected. If they become a commercial success, the acreage of cotton that one man can handle will increase to 100 or 200 acres. The present average is 20 acres in the eastern Cotton Belt and 40 acres in the western Cotton Belt.

In 1929, according to the census, about half the farms in the United States produced 90 percent of the products "sold or traded." This implies that nearly half the farmers are not needed to supply even the present commercial demand. They may be usefully occupied, to be sure, in supplying part of their own wants. Further scientific progress will enable a still smaller number to produce as much as the market now takes.

Science has achieved great triumphs in animal industry. Records of the dairy herd-improvement associations partly tell the story. These associations are organizations of dairy farmers who employ cooperatively a tester to determine the amount of milk and butterfat produced by every cow owned by their members, and to compute the cost of feed. The records help in the selection of herd sires, in the rearing of young stock, in feeding and care, and in herd culling.

In 1920 the production of butterfat per cow in the dairy herds owned by the members of 452 associations averaged 247 pounds a year. By 1928 the average had risen to 284 pounds; by 1930 the average for more than half a million cows on test was 302 pounds per cow; and by 1932 it was 310 pounds. Twenty-five years of record keeping showed a gain of 95 pounds per cow.

The dairy herd-improvement program benefited dairy practice generally. In 1900 the average production of butterfat per cow was 145 pounds a year; in 1930 it was 180 pounds. In the 5 years preceding the depression the number of dairy cows in the United States was only about 5 percent greater than it was 10 years before. The production of milk was fully 25 percent greater, yet the consumption of feed increased probably less than 15 percent.

It was science and education that brought about this increased efficiency—science expressed in plant and animal breeding, in improvements in animal husbandry, and in the use of machinery and power on the farm; and education carried to the farmer by Federal and State agencies, and by the agricultural press.

Scientific Victory Incomplete

Nevertheless the scientific victory was incomplete. When science increases the farmer's power to produce without enabling him to regulate his production, and without finding new uses for the land and labor which the improved technic releases, it does only half a job. The remaining half is to match the technical achievement with economic achievement, and to parallel the progress in production with progress in distribution.

Gains in technical efficiency, if not supported by scientific adjustments in our economic system, throw society out of balance and bring its complicated mechanism to a grinding halt. We need economic machinery corresponding in precision, in power, and in delicacy of adjustment to our technical machinery.

Population statistics warn us that the problem is urgent. Both in the United States and in Europe the birth rate has dropped; and this country has checked immigration. Ten years ago our population was increasing nearly 2,000,000 a year; now the increase is only about 800,000. England and Germany, formerly great markets for American farm products, will probably have stationary populations within a decade, and eventually declining populations. It now appears that the population of the United States will probably cease to expand about 20 years hence. It is significant, too, that the consumption per capita of many farm products has shown a decline in recent years—a 10-percent drop since 1928. How can we reconcile increasing productivity in agriculture to a declining demand? This is the supreme question of our time.

It is vain to propose letting inefficiency take over the job of reducing the volume of the surplus. Man is not built that way; if he were, he would still be in the primeval mud. Putting a brake on science is not the solution. Farmers realize that competitive necessity forces them to keep up to date. Failure to do so puts them at a disadvantage not merely in world trade but in home trade, because efficient production from abroad enters into the situation. A return to more primitive methods of production, or even neglect to keep abreast of average technical efficiency raises costs more than it raises prices.

The problem is to adjust production to the existing effective demand, to divert productive power from the creation of surpluses to the satisfaction of wants, and to open new channels into which

economic energy may profitably flow. As an emergency-relief measure, it is fitting to reduce production; but the ultimate solution requires an increase in consumption, so that we may establish an economic balance that can be maintained.

Problem of Distribution

It is essentially a problem of distribution. We have surpluses, in industry as well as in agriculture, largely because the laws that govern the distribution of income cause a polarization of wealth and poverty, a piling up of purchasing power at one end of the social scale. In consequence a majority of the people spend all their money before they have satisfied their wants, while a minority satisfy their wants long before they have spent their money. There results an unemployed block of purchasing power which tends to be transformed into capital and to go back into production instead of entering the market for consumable goods. This makes the surplus situation worse.

Potentially, the purchasing power existing at any time equals the supply of goods; but it does not necessarily enter the market for those goods. To make it do so, it must be joined to need or desire. When purchasing power gravitates away from need or desire, it lies idle or runs to waste in speculation and bad investment. How much more socially intelligent it would be to redistribute purchasing power in such a way as to put it effectively to work. Unemployed purchasing power means unemployed labor and unemployed labor means human want in the midst of plenty. This is the most challenging paradox of modern times.

COTTON-ACREAGE REDUCTION

The need was specially acute this year for controlling the production of cotton. In the marketing season 1932–33 the total supply of American cotton was no less than 26 million bales, half of it from the carry-over and the other half from the 1932 production. Our cotton production had been maintained at a fairly high level since 1929, despite a sharp drop in the world's consumption of American cotton. In 1930–31, for example, the consumption was only 11,000,000 bales, as compared with 15,000,000 in 1928–29. Cotton prices to farmers in February 1933 averaged 5.5 cents a pound. The low point was reached at 4.6 cents a pound in June 1932.

These figures may be compared with the prices received by farmers in the years immediately following the war, because farm expenses including interest and taxes had declined only moderately from the post-war peak. Farmers received an average price of 35.2 cents for their cotton in 1919–20, of 28.7 cents in 1923–24, and 18 cents in 1928–29. In the general price situation that prevailed in the first half of 1933, cotton prices to farmers should have averaged 12.7 cents a pound to give cotton its pre-war exchange value. This price for cotton was therefore provisionally the objective of the cotton-adjustment program.

Circumstances early in 1933 pointed to a worsening of the cotton-surplus problem. Growers felt driven, despite the disastrously low

price of their staple crop, to increase the acreage devoted to it. They had no other cash crops to which they could profitably turn, and the necessity to grow something for revenue was compelling. The low unit price of cotton obliged the farmers to think about having more units to sell. Accordingly, they planted 40,798,000 acres to cotton, as compared with 35,939,000 acres harvested in 1932.

In view of the peculiar conditions, this was not an abnormal increase. It was, however, somewhat larger than price analysis had predicted. It was renewed evidence that the law of supply and demand, which is supposed to curtail production when prices are low, does not always have that effect, particularly in agriculture. Under extreme pressure farmers operating competitively act in a manner exactly contrary to their collective interest. They increase production when it should be decreased. Many former attempts to adjust farm production came to shipwreck on this particular reef. Farmers who were inclined to cooperate faced the knowledge that if they did they would have less cotton to sell than usual, whereas noncooperators would probably have more.

Above-Average Yields Indicated

On the acreage originally planted to cotton this year, average yields would have given a production of 13,900,000 bales or thereabouts. As the season advanced, it became clear that the yields would be above the average. The October report of the Crop Reporting Board estimated 205.3 pounds per acre as compared with a 10-year average of 167.4 pounds. Had the crop been allowed to mature on all the acreage planted, the production would have been approximately 17,135,000 bales (according to the indicated yield as of October 1)—the second largest crop on record. With such a crop, the price of cotton would inevitably have declined again. Against the weight of an increasing supply already much too large, the commodity could not have held its place in the general advance of prices that has resulted from the Government's monetary and industrial policies. While other farm-commodity prices were climbing, cotton would have entered upon a new decline. It need scarcely be said that such a development would have meant utter ruin for thousands of cotton growers and additional distress for the South and for the Nation as a whole.

Shortly after the enactment of the Agricultural Adjustment Act, the Adjustment Administration held a conference with the directors of extension of the 16 cotton States. They recommended action under the new law to eliminate at least 30 percent of the planted cotton acreage. At another conference, growers, manufacturers, and handlers of cotton made a similar recommendation. Accordingly, on June 19 the Administration announced a program of cooperation between the Government and the cotton growers. It offered two plans: (1) A cash payment per acre to the individual farmer in return for an agreement to reduce his cotton acreage; and (2) a cash payment per acre plus an option to buy, at 6 cents a pound, a quantity of Government-owned cotton equal to the farmer's reduction in output. These payments were to vary with the prospective yields per acre. More was to be paid for high-yielding than for low-yielding land.

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It was the theory of the option plan that cotton, as a result of the acreage reduction and also of the Government's general recovery policy, would rise in price sufficiently to give the option holders a satisfactory profit.

These plans, the Adjustment Administration announced, were to go into effect if a sufficient number of cotton growers offered to reduce their acreage. It was felt that the prospective output should be reduced at least 3,500,000 bales, the normal production of about 10,000,000 acres. Through the Extension Service and with the assistance of 22,000 voluntary workers, it proceeded to sign up growers in formal contracts to reduce their acreage in return for specified payments. This was a tremendous task. The physical difficulty of getting contract forms and other data into the field taxed available facilities to the utmost. It became necessary to extend the time originally allowed for the farmers to make offers of acreage reduction. Offers were received up to midnight July 12. The signing of each offer required recommendations from the county committee and the county agent, after proper inspections of the acreage involved. Everything possible was done to prevent fraud and to keep producers from overestimating their yields. Farmers responded generally. On July 14 the Administration announced that sufficient acreage had been offered to warrant putting the program into effect.

Estimated Acreage Withdrawn

Estimates in September indicated that 1,031,000 cotton producers had contracted to withdraw 10,396,000 acres, on which the production if the crop had been allowed to mature would have exceeded 4,300,000 bales. The acreage offered, and the reduction in production, ran materially above the minimum established as necessary. The cash payments averaged about $10.60 an acre and aggregated approximately $110,000,000. Straight cash payments varied from $7 an acre for land producing 100 to 124 pounds to $20 an acre for land producing 275 pounds or more per acre. Under the plan calling for a cash payment plus a cotton option, the cash payments ranged from $6 an acre for land producing 100 to 124 pounds, to $12 for land producing 275 pounds or more. Participants in the option plan will have in addition the difference between the purchase price and the selling price of the option cotton. There has been a margin in their favor consistently since the plan went into effect. The option contracts provide that holders may not dispose of their cotton at less than 9½ cents a pound prior to December 1, 1933. They may call their options at any higher price up to that date or may renew them up to May 1, 1935, by paying the carrying charges (estimated at 40 cents a month per bale). This applies to the period from May 1, 1934, to May 1, 1935.

In preventing the cotton planted on 10,396,000 acres from maturing, the growers who cooperated with the Administration besides strengthening the cotton market, manifested a spirit that augured well for the success of future control operations. They estimated their prospective yields very moderately. As already noted, the average yield of cotton per acre for the United States as a whole was estimated by the Crop Reporting Board in October at 205.3

pounds. The October forecast of production was 12,885,000 bales. On the acreage withdrawn from production, the withdrawal contracts fixed the probable yields at an average of only about 184 pounds. This is the more striking when we bear in mind the fact that the worst lands were rejected.

The Administration accepted no land that did not give evidence of producing more than 100 pounds per acre. It refused flooded or droughty land. In checking the farmers' offers, the Administration obtained statements of the 1932 production and checked these statements at the gins. Some farmers reported their 1932 production as less than the gin records showed they had ginned. Growers complied wholeheartedly with the need to destroy completely the cotton on the acreage covered in their contracts. Reports of failure to comply with the requirements of the program were extremely rare.

Cotton Processing Tax

In accordance with the provisions of the Agricultural Adjustment Act, the Administration announced a cotton processing tax effective August 1. It fixed the tax at 4.2 cents a pound, the difference between the farm price of cotton on June 15 and the fair-exchange value of cotton on that date. As defined in the law, the fair-exchange value is a price that will give cotton a purchasing power in terms of other commodities equaling its purchasing power in the pre-war base period—August 1909 to July 1914. The processing tax is intended to defray the costs of the acreage reduction. It applies to the first domestic processing of cotton—specifically to spinning, manufacturing, or other processing except ginning. It does not apply to linters. In addition, the Administration placed a tax equivalent to the processing tax on all articles manufactured wholly or chiefly of cotton that were in stock on August 1, 1933. It excepted retailers' stocks, unless they were held until September 1. Retailers therefore had 30 days in which to dispose of their stocks without paying the tax.

It is expected that these taxes, in the main, will be passed on to consumers, whose power to pay them will be increased by the Government's general recovery program. There is no way to determine the extent to which prices to consumers will be raised. Consumers' prices have risen already from the low levels that prevailed last winter. Part of the increase may be attributed to the increase in manufacturing costs necessitated by adherence to codes of fair competition. Part may reflect inflation. Part may have resulted from the processing and floor-stocks taxes—it is impossible to measure separately the relative influence of these different factors. However, the taxes are low compared to the total cost of cotton goods to consumers. Furthermore, the law requires the Agricultural Adjustment Administration to prevent unfair pyramiding of the tax in consumers' prices.

Some Probable Results

As to net results of the whole campaign, it is too early to speak. Nature produced cotton abundantly this year and thus complicated our task. Cotton suffered much less from the drought than did the

main northern crops. The new crop, added to the carry-over of something less than 12,000,000 bales, gives a supply of American cotton larger than that of any year prior to 1931. It gave a supply of approximately 10,000,000 bales in excess of the world's consumption in 1932–33, and far above any probable consumption in 1933–34. The reduction of acreage this year merely prevents the surplus from growing oppressively larger. It does not by any means sufficiently reduce the oversupply, and the situation in the Cotton Belt remains critical.

In all probability, however, the withdrawal of 10,396,000 acres from production benefited the cotton-price situation more than may appear. It is a truism that overproduction depresses prices cumulatively. Each addition to the supply forces prices down with a disproportionately increasing effect. The same principle works in the opposite direction. Removing the top of the surplus has a proportionately greater beneficial effect than removing equal amounts later. It may reasonably be concluded, therefore, that the 1933 cotton-reduction campaign achieved as much as could have been expected, in view of the unexpectedly large production on the acreage remaining for harvest. More important still, it blazed the trail for more extensive efforts in the future.

It must be remembered that the 1933 campaign started under certain unavoidable handicaps. In the first place, it followed an unusually liberal crop-production loan program, which had been set in motion earlier. There is nothing essentially wrong about arranging production credit for the farmer, but it needs to be linked up with the acreage-reduction program. Hereafter it will be important to handle production credit in harmony with crop control. Secondly, the season was far advanced before acreage-control action could be taken. The Agricultural Adjustment Act was approved May 12, but essential amendments to it in the National Recovery Act did not become law until June 16. By that time much of the cotton crop was in the ground. As previously mentioned, it was July before the acreage-reduction plan went into operation. Up to that time the farmers had obeyed the customary incentives to maintain production as an offset to low prices, and the amount of acreage reduction necessary to influence the market in the required degree was much greater than would have been the case had it been possible to announce the plan before planting time.

Cotton prices started to advance in the spring, along with the decline in the gold value of the dollar and the growing evidence that measures would be undertaken to control the production. By the beginning of the 1933–34 marketing seasons, prices to producers had risen to above 10 cents a pound. From the peak, however, the prospect of heavy yields and other influences caused a reaction. In consequence the fair exchange value, at this writing, is not in sight.

Need for Long-Time Program

Certain conclusions may be drawn from these facts and from the general cotton situation. It is necessary to have a cotton program covering not simply one season but several seasons. The cotton surplus was not created in one season, nor will it be removed in one.

Adjustment of cotton production to the demand is essentially a long-time proposition. It cannot be achieved by hasty improvisations based on weather indications at the beginning of a single season.

In the 1926–27 season the United States produced 17,978,000 bales; in the succeeding season it produced only 12,956,000. Yet the harvested acreage dropped only from 44,616,000 to 38,349,000 acres. It was nature that mainly determined this great change in the volume of production. Such facts are common, and growers are so impressed by them that they are often pessimistic as to the possibility of regulating production. In the partnership between man and nature, they imagine that nature has the deciding voice.

This is not the case. It is only for brief periods that nature seems to decide the matter. In the long run the action of the weather and other natural influences is surprisingly uniform. Favorable conditions in one season offset unfavorable conditions in another. Over a term of years the deciding factor in the volume of production is a controllable factor, namely, the acreage. In the period 1898–1902 the cotton area of the United States averaged 25,675,000 acres, and the production 10,176,000 bales. In the period 1927–31 the cotton area averaged 41,036,000 acres and the production 14,657,000 bales. Production increased with the acreage, falling a little behind because the invasion of the bollweevil and other factors reduced yields somewhat but remaining in a very stable relationship with the acreage. Over a term of years the growers decide how much cotton shall be produced.

As an emergency proceeding, the course taken in 1933 met the requirements successfully. It need not on that account be taken as the necessary basis for a long-time policy. Farmers this year plowed up cotton after it was planted, an action much against their instincts. It seems obviously preferable to have an agreement in advance, so that what should not be grown will not be planted.

Plan for 1934 and 1935

The 1933 program prevented a disaster, but it was only the first step in the control of cotton production. It is planned in 1934 to limit the acreage to approximately 25,000,000 acres.

At conferences with representatives of the Agricultural Adjustment Administration growers and others interested endorsed the plan, which may be extended into the 1935 season. A committee representing nine cotton-growing States recommended immediate announcement of the program, so that growers would have ample time to prepare for it. Accordingly, the Administration issued an outline of the project on September 22.

It is intended to reduce the number of bales or the net production, and the allotment principle is applied. Acreage rentals will be paid on the land left out of production, plus benefit payments in amounts tending to give participating producers an income representing prewar exchange value on the domestically consumed proportion of their crop. It sets 25,000,000 acres tentatively as the figure to which the total cotton area should be reduced, but the real object is a decrease in the output. The plan will be administered with that end in view.

Acreage to be planted will be allocated among cotton-producing States on the basis of a ratable proportion of the 5-year (1928–32) average. To each county will be allotted its ratable proportion of the State's average.

County allotment associations will be formed to allocate to each farm operator his proportion of the county allotment. If land has not been planted to cotton continuously, the production of adjacent or similar land will furnish the basis for allotments and payments. The Secretary of Agriculture may prescribe uses for the acreage rented and may limit or restrict the crops to be produced thereon.

No rental or benefit payments will be made in advance of the actual planting. The amounts of such payments will be determined by the county association, subject to the approval of the Agricultural Adjustment Administration.

Producers must apply for membership in the county associations and must offer to enter into acreage-restriction contracts. Membership will run for 2 years and will obligate members to comply with any requirements which the Secretary of Agriculture may make as to acreage reduction or crop production for 1934 and 1935. Regulations for 1935 will not require an acreage reduction exceeding 25 percent of the 5-year average and will allow compensation on the same basis as for 1934.

Benefit payments on domestic allotments will be made, not on the total acreage planted but on the production for domestic consumption. In the 5-year period ended July 31, 1933, the average annual domestic consumption of cotton was approximately 5,565,000 bales. This quantity of cotton, allocated to the counties and thereafter to the individual producers ratably, establishes the basis for the payments.

If the price for the season plus the rental for the land taken out of production fails to bring the farmer's income from his share of the domestic consumption up to the parity price, he will receive a supplementary cash benefit tending to make up the difference.

WHEAT-ACREAGE REDUCTION

As previously noted, the wheat producers of the United States faced a gloomy situation in the early days of 1933. This country had accumulated since 1928 a supply of wheat from 125 million to 260 million bushels above its normal supply. This surplus constituted more than half the world's surplus of wheat. It disrupted and disorganized the wheat-price structure and impelled foreign countries to impose trade restrictions as a protection to their own growers. Our wheat carry-over at the end of the crop year 1932–33 reached the record figure of 363 million bushels. The foreign market had practically vanished. These circumstances forced down the price of wheat, which on January last averaged 31.6 cents a bushel at the farm. In the 5-year period August 1909 to July 1914, wheat in this country averaged 88.4 cents a bushel at the farm. Wheat prices early this year were far out of line with the prices of goods that farmers buy, and debts and taxes remained as high as when wheat brought three times as much per bushel.

To correct this situation the Agricultural Adjustment Administration put into effect a plan for reducing our wheat production. Its fundamental purpose was to enable each cooperating grower to shift his production to a lower level and to finance him in some measure while making the change. Specifically, the program provided for adjustment payments to each cooperating producer based on his proportionate share of the domestically consumed part of our wheat crop. This proportionate share became known as the farm allotment. It bore the same proportion to the total domestic consumption that the farmer's average 3-year production bore to the average total 3-year production of the United States during the period 1930–32.

In return the producer agreed to reduce his acreage for the 1934 and 1935 crop years. It was stipulated that the reduction required should not exceed 20 percent of the farmer's acreage. Subsequently the Adjustment Administration fixed 15 percent as the required reduction for the current crop year. In putting the program into effect the Administration offered contracts to 1,200,000 individual farmers in 40 States and more than 2,000 counties. It arranged for the organization of county associations to administer the program locally. The Department's Extension Service conducted an educational campaign among farmers, and helped to organize the county associations. Committees of these associations checked, corrected, and approved farmers' reports of production and acreage and determined the individual allotments. The associations helped greatly to reduce the cost of administering the acreage-reduction plan.

Response of the Wheat Industry

Wheat producers generally recognized the soundness of the principles involved. They recalled that previous attempts at controlling production had broken down because the participants had no advantage over nonparticipants, but on the contrary suffered a disadvantage. Their action improved the market for outsiders who rushed into it sometimes with an increased volume of production. Farm organizations emphasized this fact at a hearing held in Washington on May 26 and urged wheat adjustment on the basis of individual allotments. Grain-handling agencies for the most part supported the proposal.

Reports are not yet complete as to the number of cooperating farmers. If all wheat farmers sign up, approximately $120,000,000 will be paid to them, two thirds this autumn and one third after spring planting next year.

The cooperation of all the eligible farmers would mean, with the 15-percent reduction in their individual acreage, a total reduction of 9,600,000 acres. On the basis of average yields, this would reduce production about 124,000,000 bushels.

As provided in the Agricultural Adjustment Act the Administration imposed a tax on wheat processed for human consumption, to provide funds for the reduction program. The tax, which was fixed at 30 cents a bushel, was proclaimed June 26, 1933. The amount of wheat on which the processing tax will be paid was estimated at

460,000,000 bushels, or slightly more than 54 percent of our average wheat production in the 5-year period 1928–32. The payments to farmers for the crop year 1933 were fixed at 28 to 30 cents a bushel. The Administration estimated that 515,000,000 bushels of wheat would be used for human food during the year. The Agricultural Adjustment Act exempts from the tax all wheat processed by or for the producers. This quantity was estimated at 30,000,000 bushels. There was a further exemption from the tax of 25,000,000 bushels of wheat for use, in the form of flour, by charitable organizations. These exemptions left 460,000,000 bushels net as the amount on which the processing tax will be paid.

Wheat prices and also the prices of flour and bread rose after the imposition of the tax. Some persons contended that increases resulted exclusively from the processing tax. This was obviously incorrect. Wheat damage developed about the time the tax was imposed, and there was much talk of inflation. A major speculation movement took place. For a short time May wheat options in Chicago reached almost the pre-war parity. Subsequently, the speculation flurry subsided and prices declined. The whole movement, however, obscured whatever effect the processing tax may have had upon the price of wheat, flour, and bread. It is probable that the tax was responsible for an increase of only about one half cent per pound loaf of bread.

Provisions of the International Wheat Agreement

The general international wheat agreement among the importing and exporting countries signed by many of the countries at London, August 25, is conditional upon agreement by the four exporting countries as to restriction of their production and exports. A supplementary agreement between these four countries putting the principles into specific form has not yet been placed in final form and approved.

The most significant elements in the general agreement are:

1. The major wheat importing and exporting countries of the world face the facts of the world wheat problem and agree on a program of action to seek to correct them.
2. The exporting nations agree to control exports and to adjust production so as to help eliminate the excessive carry-over of wheat.
3. The wheat-importing countries agree to cease further efforts to expand their wheat production and agree to a policy of gradually removing tariffs and trade barriers as world wheat prices rise.
4. The countries participating in the conference will establish a joint committee to watch the working out of various steps. This international committee will meet from time to time and will be responsible for seeing that additional steps are properly taken.

The signing of the agreement by the importing countries is a significant step toward effective world cooperation in correcting the wheat surplus. It binds them not to take advantage of any efforts that the exporting countries may take to eliminate the excess supplies, but instead to adjust the policies of the importing countries so as to assist in correcting the situation as rapidly as possible.

The importing countries bind themselves (1) not to encourage further increase in their wheat acreages, (2) to attempt to secure increased consumption of wheat and to remove gradually the

measures now lowering the quality of bread, which measures have tended to reduce wheat consumption, (3) to make a start in reducing the wheat tariffs after the world level of wheat has advanced to a point agreed upon, and (4) to modify their other restrictions such as import quotas, milling restrictions, etc., during the 1934–35 marketing season, even if they cannot do so during the current marketing season. This latter commitment is also conditioned on improvement in the world level of wheat prices.

While the commitment on the part of the importing countries to lower their tariff after wheat prices start rising may have little significance at the moment, it may become of very great importance in succeeding years. Obviously, the nearer that the world level of wheat prices approaches the wheat prices which prevail within the importing countries, the less need there will be for milling quotas, import restrictions, etc., and the easier it will be for the importing countries to carry through their commitment for the gradual abolition of these restrictions.

Landmark in International Effort

When the wheat agreement is finally concluded it will be a landmark in international efforts to solve the economic depression. Through it both the importing and exporting countries face the basic facts which have caused the abnormally low world wheat price and agree to take definite steps to correct that situation. Prices are only symptoms; production, supplies, and consumption are the underlying factors which prices reflect.

For the past 10 years the wheat countries of the world have been following irrational policies. The exporting countries have been maintaining or increasing production in the face of diminishing markets. The importing countries have been taking steps that resulted in encouraging their farmers to expand their production of wheat, even on high-cost land, in spite of the fact that wheat could be bought for very low prices in world markets. Low prices in importing countries have not restricted production. Low prices in world markets have been accompanied by restrictive measures and falling consumption in importing countries. Now all important wheat countries face these facts and agree that the future must be different. The next 5 years may see striking progress in straightening out the difficulties which the previous irrational policies produced.

The work done on the international agreement was made possible by the Agricultural Adjustment Act. In the form it has now reached, the agreement constitutes a courageous effort to face the facts of recurrent world surpluses of wheat and to grapple intelligently with the fundamentals involved. It is an effort to break the vicious cycle of surpluses, excessive tariffs, ruinous prices, economic paralysis, and bread lines in this and other countries. This Nation took the lead early last spring in initiating steps which led to summoning the conference. The State Department worked in closest cooperation with the Department of Agriculture throughout the negotiations. Premier Bennett of Canada supported the United States in getting the exporting countries to reach an understanding on principles.

Outlook for 1934 and 1935

Two factors enter into our situation as it may develop in 1934 and 1935. Neither concerns the possibility of an enlarged foreign market, which possibility depends on purchasing power abroad as well as on the wheat-price level. These two factors are (1) the actual acreage reduction, and (2) the prospective production on the reduced acreage. The year 1933 was a year of drought and low wheat yields. Winter wheat yielded only 12.7 bushels per acre and spring wheat 9.2 bushels. The average on the entire wheat acreage was 11.3 bushels, the lowest in 40 years. Total production was 506,557,000 bushels, according to the October crop report. It is usual for yields to be high following years of drought. Favorable weather conditions in 1934 may partly offset the acreage reduction, and the Nation may again face an increase in wheat supplies. In that case prices will be likely to fall, and it may be necessary to ask, under the farmers' contracts, for an acreage reduction to the full amount of the permissible 20 percent.

Another short crop year would create an opposite situation. Wheat might rise to the parity price. Such a rise would obviate the need to make adjustment payments and would warrant dispensing with an acreage reduction or requiring only a small reduction. The wheat program is flexible enough to meet a big-crop or a short-crop situation. Wheat growers who cooperate in it will have, whether the crop be large or small, a return approaching the parity price for at least part of their production.

The wheat contract binds each man who signs it to use the land taken out of wheat in such a way that it will not add to the surplus of any nationally produced agricultural product for sale. This requirement creates a problem of alternative uses for the displaced land. The contract permits this land to be summer-fallowed, to be planted to soil-improving or erosion-preventing crops, to food crops for home consumption on the farm, or to crops for the production of livestock (or livestock products) for home consumption or use on the farm.

It is extremely important to prevent erosion on the acreage removed from wheat production and to keep out noxious weeds. Pastures are one of the most satisfactory replacement crops. Grasses give good cover to the land, prevent erosion and weed growth, and ordinarily do not increase damaging surpluses of commodities nationally sold. The land-use policy cannot yet be considered fixed. Dairy and livestock farmers have an interest in the uses made of the wheat land withdrawn from wheat. It is important not to increase the commercial production of milk or meat. Substituting pastures for wheat and corn, however, will reduce the total amount of feed available for the dairy, beef, and pork industries. Pasture offers a low-pressure method of producing milk and meat which may at this time be substituted for the high-pressure feeding method which this country developed during and after the war.

EMERGENCY HOG PROGRAM

Adjustments in hog production presented extremely difficult problems. The farm price of hogs, despite an advance of nearly 50 percent from the low point of last January, remained in August

only about one half of the fair exchange value called for in the Agricultural Adjustment Act. On August 15, the farm price of hogs averaged only $3.79 a hundred pounds, as compared with a pre-war average of $7.47. Following a sharp decline in the market for speculative commodities came severe breaks in the prices of lard and dry-salt meats.

Excessive supplies during May, June, and July depressed the market in late summer. In these months the hogs slaughtered in Federally inspected plants numbered 2,750,000 more than in the corresponding months of the previous year. This was a 30-percent increase. The slaughter was about 5 percent greater than the previous record total for May, June, and July.

The movement of hog products into domestic consumption during the summer was only a little larger than in the summer of 1932. There was only a slight increase in exports. In consequence, the supply of hog products in storage increased greatly. Lard stocks on August 1 were 80 percent above those of the same date in 1932, and storage stocks of other pork products were 26 percent greater. The excessive storage stocks, hot weather in many sections, and continued heavy marketing, prevented the usual summer advance.

There was no prospect of quick improvement through the natural course of events. Supplies of hogs for market during the fall and winter seemed likely to be larger than those of a year ago. The June pig survey had indicated an increase of 13 percent in sows for fall farrowing in the Corn Belt. A sharp reduction in feed-grain supplies later suggested that the fall farrowings would be less than the June survey indicated, but nevertheless as great or greater than those of 1932.

It seemed probable also that many unfinished cattle would enter the market in competition with hog products. An extreme shortage of feed in many areas foreshadowed large market supplies of grass-fed cattle from the Western States. Because of the small corn and feed crops in most Corn Belt States, the demand for grass-fed cattle to go into the feed lots was expected to be small.

In these circumstances hog farmers recommended and the Agricultural Adjustment Administration adopted an emergency program calling for the purchase of pigs and sows due to farrow. This program involved the purchase of slightly more than 6,000,000 pigs and lightweight hogs weighing from 25 to 100 pounds at prices well above the market.

For hogs about 100 pounds in weight, the price offered averaged about $6 a hundredweight. For pigs weighing 25 pounds the prices ran as high as $9.50 a hundredweight. For sows due to farrow weighing 240 pounds or more, the Administration offered a bounty of $4 a head above the market price. It was arranged that these sows should not be subject to the usual dockage. Accordingly the actual premium per sow amounted to about $5 a head.

Methods Used in Emergency Program

Packers purchased the pigs and sows for the account of the Department of Agriculture. At the above-mentioned prices the Administration accepted only pigs in good health and showing normal growth and no body deformities. Representatives of the Department

inspected, at processing plants and public stockyards, the pigs and sows purchased under this program.

The Emergency Relief Administration purchased the meat at a price sufficient to defray the cost of processing, storage, and freight, and handled it so that it did not compete with commercial supplies.

Inedible pigs and sows, or animals which for various reasons could not practicably be used for human consumption, were as far as possible converted into salable inedible products such as grease, for which the best market prices were obtained. Wherever the price for such inedible products was so low as not to return the costs of conversion the material was dumped. Misinterpretation of this procedure, unfortunately, gave rise to rumors and press stories that human food was being wasted or dumped in the river.

To finance the undertaking the Administration arranged to collect a processing tax to average about 50 cents per hundredweight on all hogs marketed during the 1933–34 marketing season. It was estimated that the pig and sow purchases by the Administration would immediately add 30 to 35 million dollars to the income of the hog farmers. In addition, the diversion of these pigs and sows to noncompetitive edible uses and to nonedible products removed approximately one and one fifth billion pounds of hogs from the fall and winter supplies. This will result in higher hog prices through the 1933–34 hog-marketing year than would otherwise have obtained, especially from January through April.

Permanent Policy Necessary

It is necessary to follow the emergency hog-reduction plan with a more effective and permanent control. This should include corn production as well as hog production. Unless the corn acreage of the United States drops sufficiently to compensate for the reduction in hog production, the production of other kinds of livestock will be stimulated. Hog farmers moreover will be tempted to expand their operations. It is calculated that for each reduction of 10 head in the output of hogs, from 7 to 8 acres should be withdrawn from corn growing.

The excessive production of corn and hogs constitutes a problem requiring a unified program of control, which is nevertheless only part of a larger problem involving all the feed crops and all livestock production.

From approximately 100 million acres of land this country annually produces an average of 2,600,000,000 bushels of corn. This year's production, according to the September estimate, will be only 2,285,000,000 bushels from 103 million acres. The average wholesale slaughter of hogs is approximately 50 million head. Heretofore, the gross value of both corn and hogs was at a maximum when the production was 10 to 20 percent below normal. It would be desirable to reduce hog production by some 10 million head, and corn production by 350 to 500 million bushels.

A plan for reducing corn acreage by at least 20 percent and hog farrowing by at least 25 percent in 1934 has been launched. The plan involves a maximum of $350,000,000 in benefit payments to

farmers who participate. It was formulated after conferences with the National Corn-Hog Committee of Twenty-five, composed of producer representatives of 10 Middle Western States. Between 1½ and 2 million farmers in this country produce corn and hogs as a major enterprise. The majority of these are in Ohio, Indiana, Illinois, Missouri, Kansas, Nebraska, Iowa, South Dakota, Minnesota, and Wisconsin.

Payments to each farmer for corn reduction will be in the form of a rental at the rate of 30 cents per bushel on the average preceding 5-year production of the contracted acreage. Each participating farmer will receive adjustment payments of $5 per head on the number of hogs, equivalent to 75 percent of the average annual number of hogs from home-farrowed litters sold by him during the last 2 years. Announcement of the corn-hog program for 1934 followed the completion of the emergency hog program.

To be most effective, any long-time program should deal with the feed crop-livestock situation as a whole. This is not possible under the present act. It is possible that the act may be amended later to include other livestock and feed crops as basic commodities so that a complete program can be put into effect.

DAIRY-INDUSTRY ADJUSTMENTS

In considering the adjustments that are being undertaken in the dairy industry it is quite important to have a broad picture of the production situation. The number of milk cows on farms in the United States reached an all-time record in January 1933. The number of calves and heifers kept on farms for future milk production was likewise at or near an all-time peak. The pastures, forage crops, and concentrates with which to feed this mammoth dairy herd were temporarily restricted by the severe and prolonged drought which prevailed over wide production areas. Consumer purchasing power is not sufficiently large to absorb at satisfactory prices to farmers the huge quantity of dairy products these cows are capable of producing under more liberal feed conditions. These simple facts show plainly that many of the present troubles were already in the making before the Agricultural Adjustment Act came into being.

The number of milk cows was increasing more rapidly in the West North Central States and in the South Central States, where wheat, corn, and cotton predominate, than in any other section of the United States. The increase in numbers of milk cows for these two regions for the 1929–32 period was fully 10 percent. An important reason for this increase is found in the changes in the butterfat-feed price ratio. During the pre-war period, and even up to 1920, 1 pound of butterfat would buy approximately 20 pounds of grain on an average farm in the United States. During the postwar decade, 1 pound of butterfat would purchase about 30 pounds of grain. In December 1932 the same amount of butterfat would buy nearly 60 pounds of grain. In the West Central States this relationship reached a point at which 1 pound of butterfat would purchase approximately 75 pounds of grain, even though both grain and dairy prices were undesirably low. Fully 40,000,000 acres were formerly used for the

production of grains and cotton for export markets to which trade channels have been obstructed by tariffs, import quotas, and other trade barriers. Naturally there was a tendency to use these acres for the production of products for domestic use and for which prices were relatively more favorable.

The problem of improving and maintaining the purchasing power of dairymen had two major angles. The first was to curb the former trend toward dairying, and the second was to bring about a satisfactory adjustment within the industry itself. The proper place to start was naturally to raise wheat and cotton prices and thus give these farmers an opportunity to make a living without becoming commercial dairymen. The increase in grain prices in the summer of 1933 caused the butterfat-feed ratio to drop to its pre-war level, making dairy farming less inviting. For the dairy farmer producing his own feed this merely meant that more of his income might be attributed to the production of feed and less to the conversion of these feeds into dairy products. The net result is no material change in his total income. The dairyman who buys a large part of his feed and who has found the higher feed cost burdensome should remember that higher feed costs will eventually mean less excess production and higher prices for dairy products.

Measures Being Developed

Measures that are being developed under the Agricultural Adjustment Act to improve conditions within the industry can be grouped into three classes: (1) Marketing or trade agreements, (2) purchasing operations, and (3) production control.

Practically every branch of the dairy industry has a trade agreement of some kind under consideration. Fluid-milk agreements are the most numerous. These agreements are voluntary. However, they apply to both contracting and noncontracting producers and distributors through a blanket licensing provision covering all distributors of milk and cream in the sales areas. These agreements establish prices to producers for milk used for sale as fluid milk and cream and provide the basis upon which additional or surplus milk may be purchased from producers. The wholesale and retail prices are usually specified, or at least some limitations are placed on the maximum and minimum prices that may be charged consumers. Each agreement contains a code of fair practices which agencies in the market must observe. Chicago, Philadelphia, Detroit, and Minneapolis and St. Paul were among the first markets to obtain agreements of this kind. The producers' associations, distributors, and the Secretary of Agriculture are parties to these fluid-milk agreements.

National agreements are in effect for dry skim milk and for evaporated milk. Agreements for these products do not go as far in regulating prices as those for fluid-milk markets. The evaporated-milk agreement establishes the basis for the purchase of milk used for manufacture into evaporated milk, but it does not cover milk used by these same plants for other purposes. The dry-skim-milk agreement does not attempt to regulate prices beyond the limitations of discounts and commissions on certain types of sales.

A national agreement for frozen desserts (ice cream) has been considered at a public hearing and is being redrafted preparatory to its submittal to manufacturers and distributors for signature. This agreement will be supplemented with affiliated or sectional agreements which are expected to establish minimum prices to producers.

A national butter agreement is in its final state of preparation. Like the agreement for dry skim milk, it attempts very little in actual price regulation, but prescribes the methods that will cover the procurement of butterfat, as well as the distribution and sale of the butter manufactured therefrom.

After many conferences a tentative cheese agreement was prepared by representatives of various parts of the industry. The proposed cheese agreement contains the unique feature of providing for price committees to replace the present cheese boards and exchanges.

Government Purchases of Butter

During the summer of 1933 the Agricultural Adjustment Administration acted to strengthen butter prices by arranging for the purchase and removal from the market of considerable quantities of butter for distribution to the unemployed through the Surplus Relief Corporation. Consumption through the regular channels of trade, however, was not increased, and cold-storage holdings mounted. As heavy production continued it became apparent that the purchase of butter for relief purposes was not sufficient to maintain a steady market as long as production continued to exceed consumption. The removal of some butter from the commercial market was helpful temporarily, but the inadequacy of such action emphasized the necessity of developing an effective production-control plan that would hold the output of dairy products down to the amount that would be consumed at a fair price to producers. Revenue for the removal of surplus dairy products from the market and for making benefit payments to producers in connection with the program for production control was provided for by the application of a processing tax on dairy products.

The most fundamental problem that the dairy industry has before it is that of adjusting production to a point where consumers will absorb at reasonably satisfactory prices to producers the quantity of dairy products placed on the market. This will necessitate the development of one of the most important production-control plans in the entire agricultural industry.

If production should continue to increase, very serious damage might be done to the entire dairy industry. Milk production is on a domestic basis by a very slight margin. While it will probably remain on a domestic basis, yet every increase in dairy output will result in lower prices relative to prices prevailing in foreign markets. Our butter prices, low as they are, are still above the prices of butter in Copenhagen, London, and other world markets by a sizeable margin. This situation emphasizes the necessity of controlling dairy surpluses at their source.

No degree of agitation against butter substitutes will be sufficient to turn the tide. Price raising by use of the processing tax or through

marketing agreements will likely prove quite unsatisfactory to producers unless accompanied by a production-control plan. Dairy producers have no alternative except to adjust their production if they are to place themselves in a position where prices for dairy products will continue at reasonably satisfactory levels.

Excessive Distribution Charges

Dairy producers have the opportunity of placing the processing and distribution of their products on a more efficient and satisfactory basis than exists at the present time. Public hearings and investigations have revealed instances of excessive distribution charges, collusion of producers and distributors, control from superorganizations, and even " rackets " of one form or another.

Large dairy corporations have not shared with the producers and consumers the major advantages that they have had from large-scale operation and resulting lower operating costs. These advantages instead have been reflected in large executive salaries and in liberal stock dividends on capitalizations that too frequently do not rest upon intrinsic values in plant and equipment. Producers' associations, particularly in fluid-milk markets, have frequently sought market advantages for their members by entering into agreements with distributors on a basis that restricted marketing opportunities to their own members and protected distributors' profits. Such action results in higher prices to consumers in these areas and in limited opportunities for the remainder of the dairy industry. If producers' associations are to retain the full support of their members they will need to give more attention to the opportunities that exist for economies in distribution and for adjustments in charges from the farms of producers to the homes of consumers.

The threat that faces new agencies in many milk markets, the destruction of dairy plants by bombing and other means, the concessions that must be made for the privilege of selling milk in many apartment houses, are all evidences of undesirable forces at work in the distribution of milk and its products. More aggressive action is necessary to rid the industry of these undesirable elements. The Department of Agriculture, through the new powers granted it under the Agricultural Adjustment Act, is desirous of assisting the dairy industry to adjust itself to new economic conditions and to place the processing and distribution of its products on a basis that will invite the full confidence of the general public.

REDUCING TOBACCO PRODUCTION

In considering the application of the Agricultural Adjustment Act to tobacco it is necessary to recognize that there are a number of very different kinds of tobacco. Altogether 25 distinct types, produced wholly within the United States, are recognized in the official classification of the Department of Agriculture. Differences between types are due largely to the varieties of seed, climate, and methods of curing. Some of the types have similar characteristics and uses. They are grouped by the Department into the following

classes: (1) Flue-cured, (2) dark fire-cured, (3a) light air-cured, (3b) dark air-cured, (4) cigar binder, (5) cigar filler, and (6) cigar wrapper.

All the types except burley (light air-cured) and the cigar types have important export outlets, and most of them are used in several different products. For consumption in the United States, the cigar types are used in cigars and scrap chewing tobacco; burley and the flue-cured types are used in cigarettes, smoking mixtures, and chewing tobacco; the fire-cured types are used in snuff and in certain classes of cigars; the dark air-cured types are used in chewing tobacco and smoking mixtures. Most brands of products utilize several different types of tobacco; consequently there is a certain amount of competition between types.

It is perfectly natural that the existing situation with respect to the principal types of tobacco should present a complex picture. Inevitably, the changing modes of world consumption, the unfavorable influence of trade restrictions, and the increasing competition of foreign-grown tobacco have been reflected on producers of the different types in the United States with varying degrees of intensity. Prices for nearly all types reached record low levels in the crop year 1931–32, following which material reductions were made in the 1932 acreage. In the crop year 1932–33 prices of burley and the flue-cured types showed considerable improvement, prices of other non-cigar types also increased slightly, but prices of the cigar types declined to new low levels.

Difficulties Most Acute With Cigar Types

In applying the provisions of the Agricultural Adjustment Act to tobacco it was decided to begin with the cigar types. This decision was based largely on the fact that growers of these types were suffering more acutely from the accumulation of surplus than the growers of any other types. To this was added the further consideration that, at the time the Tobacco Section of the Agricultural Adjustment Administration was created, the planting of the 1933 crop of cigar tobacco was not as far advanced as the planting of other tobacco; consequently, it was believed that a plan for acreage reduction in 1933 could be put into operation more effectively for the cigar types.

Production of the cigar types ordinarily represents about 10 to 12 percent of the United States production of all types. It is used almost exclusively for domestic consumption. Briefly, the situation with respect to these types was as follows: (1) Cigar consumption has been declining over a period of 12 years; during the past 4 years it has declined 40 percent; (2) production of the cigar types has exceeded consumption for several years; (3) less than half the farmers had been able to sell their 1932 crops, and prices for the crops sold were about 50 percent below fair exchange values as defined in the Agricultural Adjustment Act; (4) surplus stocks had accumulated all the way from the producer to the manufacturer (at the current rate of consumption, if no cigar tobacco was grown in 1933 and 1934, there would be at the end of the 2 years but few

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grades of which there would be a shortage); and (5) stocks of the lower grades were larger than stocks of the better grades.

The Administration began by consulting with representatives of all branches of the cigar industry. Conferences were held with economists from the agricultural colleges of States in which the cigar types are produced, with growers and growers' representatives, and with leading dealers and manufacturers. Early in these discussions it became evident that it would be necessary (1) to define all cigar types of tobacco together (filler, binder, and wrapper) as a basic agricultural commodity, (2) to apply a processing tax to this commodity for raising revenues with which to reduce supplies, and (3) to extend the program for reduction over a 3-year period. Proposals recommended to the Administration for adoption included acreage reduction, combined with benefit payments; the removing from commercial uses of surplus farm stocks, combined with benefit payments; and marketing agreements, both with and without the licensing of buyers and establishment of minimum prices.

Projects Affecting the Cigar Types in 1933

Two projects were definitely undertaken to reduce the size of the 1933 crop of cigar tobacco, the most extensive of which related to the four districts producing the filler and binder types. It provided for reducing the acreage harvested in 1933 to approximately half that grown in 1932, and limiting the acreage in 1934 and 1935 to the same extent, or by a lesser amount, at the discretion of the Secretary of Agriculture. About 18,000 growers, or approximately 70 percent of the total number in the United States, participated in the program in 1933, and it is estimated that production was reduced about 18,000,000 pounds, or 20 percent, below what it would have been otherwise. Estimated payments to growers total about $2,500,000.

The project dealing with the wrapper type of cigar tobacco grown in Georgia and Florida provided for making payments to growers for leaving unharvested in 1933 an average of four top-stalk leaves, approximately one fifth of the total number of leaves per plant. Ninety-five percent of the growers participated in this project, as a result of which production was reduced about 350,000 pounds, or 23 percent, below what it would have been. Estimated payments to growers total approximately $85,000.

For Connecticut Valley shade-grown tobacco, a marketing agreement has been entered into between the "handlers" and the Secretary of Agriculture for the purpose of regulating the quantity of that type of tobacco entering interstate commerce. Owing to the limited outlet for cigar-wrapper tobacco, on the one hand, and the heavy investment required for production, on the other, the Connecticut Valley shade-grown industry includes less than 50 producing units. All the handlers, except one, are also producers. Thus, an agreement of this kind is peculiarly adaptable to the industry. In contrast with most agricultural products, the problem of control is relatively simple, and the coordination of group interests is not so difficult.

The agreement does not affect the quantity of the 1933 crop going into interstate commerce, as that crop was nearing maturity when

negotiations were started. But for the crop of each subsequent year (until the agreement is terminated), the quantity permitted to enter interstate commerce, and therefore the quantity produced, may be limited, subject to approval by the Secretary of Agriculture. All the tobacco including the 1933 crop shall be graded according to United States standard grades and, subject to the Secretary's approval, minimum prices may be established on each grade.

Initiating the Cigar-Leaf Program

In initiating the program for the cigar types the Administration encountered but few difficulties. To most persons the purposes were obvious, and the need was so great that all branches of the industry willingly gave their cooperation. However, with the limited time available for educational work it was inevitable that some misunderstandings should occur.

Perhaps the most difficult thing for the farmers to understand was why they should be limited in the use of the land on which payments were made. At the time the plan was announced a considerable cut had already been made in the 1933 tobacco acreage, and other crops had been planted on the land taken out of tobacco. An acute feed shortage threatened in some sections. We were aware of this and agreed that in 1933 half the contracted acreage could be used for crops to be consumed directly or indirectly on the farm, without influencing the amount received in payments. Also, the grower was given the alternative of using all the contracted acreage for such crops and accepting appropriate reductions in payments. But, inasmuch as one of the primary purposes of the Administration was to retire land from production, it was obviously undesirable to make full payments to the grower and allow him to use all the land for other crops.

Another difficulty related to the base tobacco acreage. It was provided in the contract that no producer could grow an acreage of tobacco greater than 50 percent of his base acreage, although each had the opportunity of choosing one of three methods for determining that base. Since in any given district the amount of money received in payments was determined largely by the number of acres in the base tobacco acreage, many growers tried to obtain the highest possible base, perhaps not realizing that to obtain the payments would require that restrictions be placed upon the use of the land.

Our view was that in making additional adjustments of acreage in 1933, account should be taken of the adjustments already made. For this reason, the acreage planted in 1931 and 1932 was used in determining the base. If a grower had already reduced acreage before 1933, it was assumed that other enterprises had been found to substitute for tobacco; and if the acreage had not been reduced, it was assumed that no such enterprises had been found. No doubt some growers adjusted acreage in an effort to help improve the tobacco-supply situation, but probably most of them had in mind improving their own financial position.

Meeting the Flue-Cured Situation

For flue-cured tobacco, the situation differed materially from that of the cigar types, (1) because supplies were not so excessive, and (2) because exports represent so large a part of the production (around 60 percent). Owing to the more favorable supply situation, the possibilities for immediate improvement of prices were greater, but from the standpoint of total income to growers, there was danger that too large a curtailment of production would decrease income rather than increase it. Foreign production of flue-cured tobacco has expanded rapidly in recent years, and high prices in the United States will tend to increase foreign displacements.

Prior to the opening of markets for the 1933 crop, preliminary discussions were held both with growers and manufacturers. At that time it appeared that the 1933 crop would be no larger than annual consumption, and the principal buyers expressed the belief that fair prices would be paid for this crop. The July 1 forecast was for a production of 591,159,000 pounds but as the season progressed it became evident that the favorable growing conditions would result in a much larger crop (estimated in October at 705,103,000 pounds). When the markets opened in Georgia on August 1 growers expressed considerable dissatisfaction with prices, and as the prospects for production improved prices weakened. Finally, when the eastern North Carolina markets opened (Aug. 29) at levels lower than had prevailed in Georgia and South Carolina, the dissatisfaction became so great that on September 1 all the markets were closed at the request of the Governors of North Carolina and South Carolina.

During this emergency 95 percent of the growers signed contracts with the Agricultural Adjustment Administration agreeing to reduce their production in 1934 and 1935 by an amount requested by the Secretary of Agriculture not to exceed 30 per cent of the average 1931–33 production. Simultaneously, a marketing agreement was entered into with the large domestic manufacturers using more than 90 percent of the flue-cured tobacco manufactured in the United States, to establish an average minimum price (17 cents per pound) for a quantity at least equal to the quantity which they used during the last fiscal year (about 250,000,000 pounds). They had already purchased this season about 75,000,000 pounds in addition to the quantity included in the agreement.

The markets reopened September 25 with prices at materially higher levels. Buyers for export were not included in the agreement, but they increased their prices along with the domestic buyers. If the prices now prevailing (Nov. 3) continue throughout the remainder of the season, the farmers' income from the 1933 flue-cured crop will be about two and one half times the income from the small 1932 crop. The purchasing power of the 1933 crop in terms of commodities farmers buy will be greater than that of any of the last 4 years and greater than the average for the 10-year period 1919–28. In addition to the increased income from the 1933 crop, farmers who participate in the reduction program in 1934 will receive cash payments aggregating around $17,000,000, almost $10,000,000 of which will be in the present marketing year.

Other Kinds of Tobacco

Arrangements are going forward for the adjustment of supplies with respect to the other kinds of tobacco in the United States. Burley, Maryland, fire-cured, and dark air-cured tobacco, each has been defined separately as a basic agricultural commodity. These, together with flue-cured and the cigar types, comprise all the domestic types of tobacco. A separate program is being developed for each. In general, the problem is that of reducing production to bring supplies into line with consumption. The surplus is greatest in the case of burley, although supplies are above normal for each kind of tobacco.

The total production of tobacco in the United States in 1933 (all types combined) was estimated in October at 1,413,000,000 pounds. This is approximately 200,000,000 pounds above the world consumption estimated for these types, whereas the small 1932 crop of 1,016,000,000 pounds was about 200,000,000 pounds below world consumption. The carry-over of tobacco in the United States on July 1, 1933, was 2,000,000,000 pounds, which was second only to the record carry-over of 1932 and 20 percent above the 5-year average, 1927–31, when consumption was somewhat larger than at present.

Taxing the Processing of Tobacco

Processing taxes, effective October 1, have been placed on all kinds of leaf tobacco. The rates per pound of such taxes (farm-sales weight) are as follows: Cigar leaf, 3 cents; flue-cured, 4.2 cents; burley, 2 cents; Maryland, 1.7 cents; fire-cured, 2.9 cents; and dark air-cured, 3.3 cents.

The problems relating to the taxation of tobacco are complex. Notwithstanding the fact that tobacco products have long been subject to internal-revenue taxes, the levying of processing taxes raises questions involving both the equivalence and equities of tax rates.

The particular tobacco on which processing taxes are levied is taken from storage and not the tobacco on which price differentials, or fair-exchange allowances, are established. Seldom will it be found that the quality of crops and farm prices of tobacco removed from storage will be the same as the quality and farm price of the current crop. Also, during the period of aging and fermentation tobacco undergoes losses of weight amounting to as much as 20 percent of farmers' selling weights. Thus the differences of weight have to be taken into account in making the tax levy.

The application of a given rate of tax uniformly over all grades and qualities of a given kind of tobacco, on some of which farm prices regularly vary several hundred percent, may cause shifts in the consumption of these grades and qualities. Furthermore, in taxing one kind of tobacco at one rate and other kinds at different rates there is danger that competitive relationships between types may be disturbed. In dealing with all these problems the Administration will need to proceed carefully and cautiously. If it is found that, as a result of a particular taxing program, shifts in consumption are taking place, the policy will be to take such steps as may be necessary to correct the situation.

FRUIT AND VEGETABLE AGREEMENTS

In the fruit and vegetable field, the problem of adjusting supplies to effective market demand is fourfold. It is necessary (1) to prevent excessive supplies at the height of the marketing season from flooding the market and seriously depressing prices, (2) to restrict market offerings during entire seasons of large production. (3) to regulate the flow of supply to various consuming markets so as to prevent local gluts and shortages, and (4) to control long-time tendencies toward increased production.

These four aspects have long been recognized, and various attempts have been made by cooperative marketing organizations and other groups to solve them. In a number of States, clearing-house and voluntary pro rata plans have been tried. During seasons of surplus production these have been utilized to limit the flow of supply to market. Shipments have been prorated among the various shippers, who in turn have prorated salable quantities among the various growers for whom they market. In some instances these plans have received wide support, as many as 80 or 90 percent of the growers of a given commodity participating in them. But they have had the serious weakness of permitting the growers and shippers who do not participate to profit by the action of those who do. This in turn tends to cause the participants to become dissatisfied and to break down the whole arrangement.

Attempts have been made to bolster up this weakness through the passage of State pro rata laws. Such a law was recently enacted in California. Sponsors of these laws have recognized that they could be really effective only in the few instances where a single State controlled the entire supply during the marketing season.

The Agricultural Adjustment Act opened the way for the first time to make the pro rata plans fully effective. The portions of the act providing for marketing agreements covering the various agricultural commodities and the licensing of all the dealers or processors handling these commodities made it possible to bring about complete unanimity of action. Since fruits and vegetables were not included as basic commodities under the act, funds for production-control plans could not be obtained through any processing tax, and the only method by which supply could be controlled was through the marketing agreements and licensing.

Cling-Peach Agreement

The first marketing agreement to be formally approved covered the California cling-peach industry. More than 99 percent of the output of canned cling peaches is produced in California. Thus it was possible to achieve complete control of the situation through the one agreement. The total peach pack was limited by agreement to 218,000 tons, or 10,000,000 cases. In the event that the supply of No. 1 cling peaches exceeded this amount, the pack was to be allocated among the canners through an allocation board. In case the supply was less than 218,000 tons, enough No. 2 peaches to make up the difference were to be canned.

From the growers' standpoint, the most important feature of the agreement was that it guaranteed them a price of $20 a ton for their harvested fruit and an equivalent amount for that which was not

harvested. Another feature was the setting of minimum and maximum prices, varying according to grade and classification, at which the canners might sell their peach pack. Funds for the purchase of the surplus crop were to be obtained from payments by the canners of $2.50 or more per ton for each ton of peaches they packed. Administration of the agreement was to be under the direction of a control committee of 10, representing growers, canners, and the consuming public.

Formulation of other marketing agreements, calculated to meet situations where the commodity is not canned but goes directly into consuming channels, followed approval of the peach agreement. One of these dealt with California deciduous tree fruits; another with apples and other tree fruits produced in Washington, Oregon, Idaho, and Montana; a third with California Flame Tokay grapes; and others with the citrus industry of California, Arizona, Texas, Florida, and Puerto Rico.

Each of these proposed agreements was intended to set up the machinery for the operation of pro rata plans under official supervision, with equitable treatment of the shippers and growers in the several shipping districts, so that all would contribute to the success of the plan by withholding a portion of their shipments when necessary.

The three citrus agreements, affecting the California-Arizona, Texas, and Florida producing areas, contained an identical section providing for a national stabilization plan, through the creation of two National Citrus Stabilization Committees—one for oranges and one for grapefruit. This plan was intended, in seasons of excessive production, to make possible the limitation of the total volume of supply going into market channels in the United States and Canada, and the prorating of this supply in an equitable manner among the various producing areas.

Other agreements were in process of formulation for other fruits and vegetables and the various nut crops.

The problem of controlling the prices of eggs and poultry is extremely complex. These commodities are produced on 5,400,000 of the 6,000,000 farms in the United States and are sold to millions of buyers. Another complicating factor is the cold-storage holdings of poultry and eggs. As in the case of fruits and vegetables, it is not possible to use a processing tax to finance a production-control campaign.

Series of Agreements Contemplated

Accordingly, the Administration seeks to complete a series of marketing agreements framed and coordinated so as to bring order into the production and marketing of fruits, vegetables, nuts, and other products. These agreements, integrated into a component whole, would (1) prevent seasonal surpluses from demoralizing the market, (2) level the flow of supply to market during the producing season, and (3) coordinate shipments so as to keep them rolling toward the various terminal markets as fast as, and no faster than, needed.

The benefits to the producer in the way of increased prices from such a coordinated system promise to be large. The costs of packing,

transportation, and marketing are virtually fixed charges, and unless the selling price exceeds this amount, the grower gets nothing. Therefore a small increase in the selling price in the market may result in a substantial increase to the grower. This increase, even if passed on to the consumer in full, would mean only a small percentage increase in the retail price.

Actually, important benefits are promised for the consumer also. A well-integrated marketing system, assuring an adequate supply and preventing so far as possible the alternating gluts and shortages that now frequently occur, means that fruits and vegetables will reach the consumer in better condition.

Fruit and Vegetable Situation Better

The economic position of fruit and vegetable growers in the United States as a whole is much improved over that of last year and even that of 1931. After 3 years of declining prices and sharply reduced incomes, the producers of these commodities are experiencing a reversal of the trend this year and are receiving much more satisfactory returns.

Preliminary estimates of gross income from all fruits and vegetables indicate that the 1933 total is likely to be about one half again as large as that of 1932, about one sixth larger than the income in 1931, and only about one tenth smaller than that of 1930. Gross income from fruit and truck crops is about one fourth greater than in 1932, while that from potatoes may be about trebled and from sweetpotatoes almost doubled.

A combination of circumstances has contributed to these larger incomes this year: (1) The planted acreages of many vegetables were reduced slightly—a reversal of the tendency to expand gradually in recent years; (2) unfavorable weather conditions greatly reduced yields in many of the growing areas of both vegetable and fruit crops; and (3) there has been some improvement in demand conditions, owing to an increase in employment and to a rise in wages.

As compared with 1932, the acreage of potatoes was reduced about 4½ percent, sweetpotatoes 12 percent, and all other vegetables for fresh-market shipment about 8 percent. Of course, the acreages devoted to fruit crops remained practically the same as in 1932.

While producers have made an effort to bring the production of vegetables in line with existing market demand, untoward weather conditions this season have reduced yields of both vegetable and fruit crops in many areas. The effect of these weather factors probably has done more toward balancing supply with demand than the efforts to reduce planted acreages. Drought and high temperatures in the Central States and surrounding sections reduced yields sharply.

The Season's Production

Production of all fruits together this year is approximately 2 percent below that of 1932, which was about an average crop. Production of apples, peaches, and prunes is slightly larger than last year but less than the average, while that of pears and grapes is smaller. Production of all fruits, excluding citrus, is about 12 percent below

average. Citrus crops probably will be slightly smaller than last year, but about 25 percent greater than the 1924–29 average. Two hurricanes, one striking Florida and the other southern Texas during the first week of September, did considerable damage to the citrus crops in those areas. The Texas grapefruit crop was practically wiped out.

The potato crop this year is the smallest since 1925, or about 50,000,000 bushels below that of 1932, which was an average crop. Sweetpotato production is about 9,000,000 bushels lighter than that of last year, but about 6,500,000 bushels above the average.

Production of commercial vegetables for fresh-market shipment (excluding potatoes and sweetpotatoes) is about 9 percent below that of last season and about 2 percent below the average of the 5 previous seasons, while production of vegetables for canning is about the same as a year ago but nearly 30 percent below the average production of the previous 5 years. Of the vegetables for fresh-market shipment this year, the September estimates indicated that onions are reduced about 23 percent compared with the 1932 crop; cabbage is reduced 21 percent; cauliflower, 9 percent; tomatoes, 8 percent; snap beans, 7 percent; and lettuce, 6 percent. There were some increases. The production of fresh peas was increased 23 percent and spinach 6 percent over these crops of last year.

With the shorter supplies available for market and with improvement over last season in the demand situation, prices of most fruits and vegetables are higher than they were in 1932. Fruit prices in general are up about 20 percent; potato prices are from two to three times those of last year, and there has been some advance in prices of most of the vegetables for fresh-market shipment. Most of this advance has come in the latter half of the season, at the beginning of which it became known that short crops of the major fruits and vegetables were in prospect. Also it was not until near the middle of the year that employment and pay rolls had made appreciable gains and commodity prices in general began to rise.

SPECULATION IN COMMODITIES

Speculation on the commodity exchanges handicapped the agricultural recovery program during the summer. Temporarily it pushed prices out of line with supply and demand conditions to such an extent that the need for crop adjustment seemed obviated. It raised false hopes among the farmers, belied the statistical evidence that farm production was overexpanded, and deceptively narrowed the spread between the current and the fair exchange values of wheat and cotton.

Speculative commodity prices, with minor exceptions, advanced steadily during the spring and summer. Tremendous trading activity followed the banking holiday in March. After the embargo on gold exports, the volume of trading in speculative commodities rose until it was five times greater than the average volume during the previous winter. It culminated in July with a frenzied activity in which the trading became ten times greater than that of the winter period. Prices of 10 speculative commodities showed an average advance of more than 100 percent between March 1 and July 15. Grains, hides, and rubber rose much more than that.

Speculation in grain developed with returning confidence in the business outlook and with talk of monetary inflation. As prices advanced, buyers imagined the gains would continue indefinitely. Forgetting previous reactions from unbridled speculation, the public rushed again into the speculative markets in a blind struggle to profit from an expected boom.

Undoubtedly the prime motive was a desire to anticipate depreciation of the dollar. Speculators apparently ignored other considerations. They forgot the enormous wheat carry-over and exaggerated the significance of the small current crop. Wheat, which had advanced 30 cents a bushel between March 1 and June 19, jumped another 40 cents within the next 30 days. At one time wheat futures at Chicago were 32 cents above the Liverpool futures. Open commitments in the Chicago wheat futures increased from 151 million bushels on June 1 to 200 million bushels on July 19. The latter figure was double the 10-year average for that period. Normally the open commitments moderately exceed the visible supply of grain. Last winter the visible supply exceeded the open commitments. In the speculative boom of May, June, and July last, the open interest shot up until the total for wheat, corn, and oats exceeded the visible supply by nearly twice the normal excess. This showed exceptional outside participation in the market.

This speculative activity, and the price advances temporarily produced, ended in an utter collapse. Wheat prices dropped from a high point of $1.24 a bushel for the December futures on July 18 to a low of 93¾ cents on July 20, a drop of 30 cents a bushel or nearly 25 percent in 2 days. American grain history had no previous record of so sharp a drop. Speculative buying had much to do with the advance in cotton prices that took place between March 1 and the third week in July. In that period prices in 10 spot markets advanced from 5.90 cents a pound to 11.51 cents a pound. The ensuing reaction, however, was not so sharp in cotton as it was in wheat. Cotton averaged 9.27 cents a pound at 10 markets on August 29. At this point cotton prices in terms of gold were barely higher than in March.

In October 1932 the previous administration suspended in part the reporting requirements of the Grain Futures Act. Exchange members thereupon ceased furnishing to the Government certain daily reports whereby the Government had been kept informed regarding the market operations of large traders. Instead the Chicago Board of Trade agreed to see that trading would be properly conducted and to inaugurate a reporting system of its own. In approving this change, the previous administration announced that the modification "would remain in effect until notice of hearing on the reinstatement of the regulations shall have been given or until undue price fluctuations or price levels occur which indicate manipulation of the market." It cannot be asserted positively that the market would have gone less wild had the reporting regulations remained in effect. In all probability, however, these regulations would have exercised some restraining influence.

After the slump on July 19 the Government restored the reporting requirements. The Chicago Board of Trade acted to prevent a panic. It suspended one large speculator, closed the futures market for 2 days, and fixed temporary price limits. It prohibited trading

in futures at prices falling below or rising above the closing prices of the previous day by more than certain amounts. It abolished trading in indemnities, otherwise known as "bids and offers." Officials of the exchange declared that trading in indemnities had been largely responsible for the accumulation of unwieldy speculative lines. The exchange, they said, had no knowledge of the commitments thus made.

The grain exchanges on September 9 formally submitted a code of fair competition to the Agricultural Adjustment Administration, with an application for a formal public hearing.

The code as submitted proposed a sliding minimum-percentage scale for margins on futures contracts, continued the existing limitations on daily fluctuations, and provided that removal of the limits be subject to approval by the Secretary of Agriculture. It contemplated the self-policing of trading by a special force of nonmembers in each exchange, and contained clauses regulating employment conditions. It had the formal approval of the Chicago Board of Trade, the Minneapolis Chamber of Commerce, the Duluth Board of Trade, the Omaha Grain Exchange, the Merchant's Exchange of St. Louis, the New York Produce Exchange, and the Milwaukee Grain and Stock Exchange. The Kansas City Board of Trade and the Buffalo Corn Exchange announced their intention to sign the code.

The sliding minimum-percentage-margin requirements provided for a 10-percent margin for individual purchases or sales of any one grain up to 250,000 bushels, a 15-percent margin on sales or purchases of between 250,000 and 2,000,000 bushels, and a 20-percent margin for more than 2,000,000 bushels. Hedging and spreading trades, and trades offset by future trades in another grain or in provisions on the same or another exchange, were to be exempt from minimum-margin requirements.

The Functions of Trading in Futures

Trading in futures is an important part of our present system of grain marketing. A reasonable amount of speculation gives a liquid character to the futures markets and aids in furnishing a readily available means whereby grain merchants may hedge their risks. Trading in futures also serves as a barometer of prices, a reflection of market factors, material and psychological. But it is one thing to recognize a legitimate place for futures trading and another to accept uncritically all the abuses to which it may give rise. Uncontrolled speculation, particularly uncontrolled speculation by individual large operators, destroys whatever value the system may normally possess. Such speculation, always obnoxious, becomes particularly obnoxious when the country is engaged in efforts to regulate farm production. Uncontrolled speculation does not go well with controlled production.

Government supervision has had a wholesome effect and has curbed grain speculation materially and usefully since the Grain Futures Act was passed in 1922. It has caused the elimination of many faulty practices and has led to remedial action by the grain exchanges themselves. It has met with opposition, chiefly from persons who maintain that speculation stabilizes markets and lessens

price fluctuations. The most violent opposition has always come from those who profit most in commissions or desire other monetary gains from a large volume of speculative business.

Up to a certain point, speculation may have the effect of stabilizing markets and lessening price fluctuations. Beyond it, opposite results develop. Information furnished to the Government under the terms of the Grain Futures Act has shown repeatedly that uncontrolled speculation dominates price movements for short periods to the injury of the farmers and the community in general. Individuals have sometimes held speculative lines exceeding 10,000,000 bushels. Single traders have, on certain days, done a volume of business exceeding 10 percent of the total futures business done on those days. Federal supervision of grain-exchange trading is necessary, as this year's experience demonstrated anew.

It is perfectly true that improper speculation, if it takes place on the exchanges, does not wholly originate there. There is consequently no point in blaming the exchanges exclusively. Speculation has wide-spread sources among the general public, among people who want to put themselves in a favorable relation to changing values. They may realize fully that the collective result of their individual speculations may be disastrous; but they are as powerless to control the result as are farmers acting individually to control farm production. It is imperative for the Government to supervise, and if necessary to regulate, grain speculation, because such supervision is the only means of preventing abuses.

FARM INCOME FROM 1933 PRODUCTION

It is not yet possible to estimate closely the probable gross farm income from the sale and home consumption of farm commodities produced in 1933. Available data indicate $6,100,000,000 as the total. This estimate will be revised next spring, on the basis of more complete figures as to marketings and prices. Returns to the farmers will be augmented by payments from the Agricultural Adjustment Administration for the curtailment of acreage and other restrictions in agricultural production. The total of these payments is not yet definitely known. It is conservatively estimated at $300,000,000, which amount will bring the total gross income of the farmers to about $6,400,000,000. This is a substantial increase over the $5,143,000,000 received in 1932; but it is below $6,911,000,000, the income in 1931.

In the prospective increase the major factor is a sharp advance in the prices of nearly all farm products. Part of the advance was a response to a decrease in crop production, and to the resulting diminution in the volume of the surpluses. Part reflected an increase in consumer purchasing power, and an increase in the utilization of farm products by industry. Marketings of livestock, however, increased somewhat, owing to feed shortages and poor conditions in ranges and pastures. The increase in the supply of meats was accompanied by only a moderate improvement in consumer demand, and it restricted the income from livestock.

The index of farm-commodity prices advanced from 49 percent of the pre-war level on February 15 to 76 percent on July 15. It declined somewhat thereafter but on August 15 was still 40 percent

above the February level and nearly 20 percent above the level of August 1932. Farm-commodity prices in the last quarter of the year are important in determining the gross farm income, and changes in this period may affect materially the estimate given above. There was a close relationship during the spring and summer between the farm commodity price level and the trend of business activity. A continued increase in industrial activity would undoubtedly mean additional improvement in the demand.

Reduced Supplies Strengthen Prices

Reduced production strengthened the supply situation. Wheat output was below normal domestic requirements, and the carry-over declined for the first time since 1926. However, the supply remained excessive. Supplies of other grains were less burdensome, though the carry-overs were large. Production in 1933, however, was greatly reduced, and the total supply of feed grains is now below the supply in any of the last few years except 1930. By taking out of production approximately a quarter of the acreage planted to cotton, the growers of that commodity reduced the season's output to a point below the world's average annual consumption of American cotton. As previously noted, however, the production and the carry-over combined constituted an excessive supply.

Production of cigar-type tobaccos, which had exceeded the consumption for several years, was reduced by more than 30 percent. This curtailment resulted partly from the reaction of the growers to the unusually low prices that prevailed last year and partly from the acreage-reduction campaign of the Agricultural Adjustment Administration. Low prices caused a reduction in the output of many other crops, such as potatoes, flax, rye, and numerous truck crops, with favorable effects on their market position. On the other hand, the production of most of the major fruit crops slightly exceeded that of 1932, though remaining below the average. The demand increased, however, as a result of improvement in the economic situation generally, and the prices of most fruits ruled higher than in the previous season.

Inspected slaughter of hogs in the first half of 1933 was 3 percent greater than in 1932, and the average cost to packers declined. This cost was $3.72 per hundredweight, as compared with $3.74 during the first half of 1932. Slaughter in the second half of the year will probably exceed that of the second half of 1932, because the number of hogs 6 months old and over on June 1 showed a 13-percent increase, and there was an increase of 3 percent in the number of spring pigs saved. In the Corn Belt the increases amounted to 20 and 4 percent, respectively. The Administration's plan for buying sows bred to farrow in the fall and pigs under 100 pounds will not affect materially the amount of pork available for market during the remainder of the present year. It will improve the market, however, and will greatly reduce the prospective supply for the first half of 1934.

Cattle and calf slaughter likewise was larger this year than last. In the first half of 1933 the inspected slaughter of cattle exceeded that of the corresponding period in 1932 by nearly 6 percent. Yet the cost to packers was about 12 percent less. An increased number

of cattle and unfavorable range and pasture conditions over much of the country caused increased fall marketings, and with outlets reduced, slaughter increased sharply. Calf slaughter during the year showed an increase, and calf prices ran below those of 1932. Sheep and lamb slaughter fell slightly below that of 1932. Prices of new crop lambs during the summer went above the level of the previous summer. The gross income to farmers from all livestock sales during the first half of 1933 was lower than during the same period in 1932. Income for the second half will be larger.

From March to August factory employment and pay rolls increased 22 and 39 percent, respectively, and such changes usually produce somewhat later an improved consumer demand for meats.

Income From Livestock and Poultry

Farm income from livestock products and from poultry and eggs in 1933 seems likely to be about the same as it was in 1932. Among these products, wool shows the greatest change. The season's clip was only about 1 percent greater than that of 1932, and there was a marked increase in wool textile activity. In consequence, the summer witnessed one of the sharpest advances in wool prices on record. In the most important marketing period for wool, April to July, inclusive, the farm price of wool averaged 18 cents, as compared with 8.5 cents in the corresponding period last year.

The production of milk on farms during the first half of 1933 was about the same as that of the first half of 1932, though the number of cows on farms was larger. High-priced feed and poor pasture conditions tended to restrict milk production. In the first half of the year the prices of whole milk and butter averaged below those of the first half of 1932, but July and August prices were above those of the same months last year. If the improvement continues to the end of the year, the gross income from dairy products should equal that of 1932.

There is an increased supply of poultry for market, but owing to heavy marketing of layers due to low prices of eggs and increased prices of feeds the supply of fresh eggs for the fall and winter will probably be less than that of last year. Up to the middle of September the prices of eggs ruled about the same as in the corresponding period of 1932. The prices of chickens ruled considerably lower. The total income in 1933 from poultry and eggs will probably be little less than that of the previous year.

The Price Trend

In February the general level of the prices of farm products, and also the exchange value or purchasing power of these goods in terms of other commodities, reached the lowest point on record, 49 percent of the pre-war average. The farmer had to bring two wagon loads of farm products to market in order to get in exchange the same quantity of other things that he could have obtained for one wagon load in the period 1910–14.

Some farmers increased their production and sales in an effort to maintain their standard of living. Nevertheless, the broad result

was a sharp curtailment in purchases by farmers, who lived more nearly on what could be produced on the farm. All branches of business felt the effect. Reduced buying by farmers cut down industry, employment, and pay rolls. In this paralysis of trade between the country and the town, farmers saw no hope of escape from the necessity of selling their products below cost. They fed the cities, at the price of their own progressive ruin.

In March the new administration initiated the legislative program which produced the Agricultural Adjustment Act and the National Recovery Act. It dealt with the banking crisis and with monetary problems. Farm-commodity prices improved slightly in March, and substantially in April and May. In July there was sharp speculative advance followed by a reaction. From mid-March to mid-October, however, the net gain was 47 percent. There was not so great a gain—only 22 percent—in the exchange value of farm products from March to October, because prices paid by farmers advanced considerably. Some farmers, notably the beef-cattle men, lost purchasing power between March and October.

Among numerous factors that contributed to the advance in farm commodities were a reduction in the supply of some products, a general belief that economic conditions were improving, depreciation of the dollar in foreign exchange, increased business activity and employment, the replenishing of depleted stocks of goods, and increased buying by consumers in anticipation of higher prices. Reduction in supplies had much to do with the advance in the prices of grain and potatoes. The wheat and oat crops were the smallest in 40 years, and the corn crop was the next to the smallest since 1901. As already noted, however, the carry-over of these grains was above the average. A 14-percent reduction in the potato crop was more than offset to the growers by price gains. Market supplies of cattle, hogs, and butter were unusually large; nevertheless the prices of these products were fairly well maintained.

Depreciation of the Dollar

The depreciation of the dollar in foreign exchange affected mainly cotton, tobacco, and grain. It had less influence on most other farm products, and very little on those governed chiefly by local condition. On October 31 the dollar was worth only 64.4 cents in terms of French, Dutch, and Swiss gold moneys. During the summer speculation connected with the depreciation furnished additional, though temporary, stimulus to cotton and wheat prices. In a swift reaction these commodities fell sharply, but improved in September and October. Commodities sold mainly in the domestic market did not advance materially, except in cases (as for example potatoes) in which supplies were greatly reduced. Beef-cattle prices in October were about as low as they were in March, and in terms of gold as well as in purchasing power were decidedly lower than in March.

It is important to compare the above-mentioned domestic price movements with price movements in other currencies. From early April to the third week in July, wheat prices at Chicago in terms of the dollar advanced 84 percent and cotton prices at New York advanced 71 percent. In terms of sterling during the same period,

wheat and cotton prices at Liverpool advanced only 22 percent. Comparing prices for the fourth week in October with the level of prices during the first half of April, wheat prices at Chicago in dollars had advanced 48 percent whereas wheat prices at Liverpool in sterling were 3 percent lower; in terms of gold wheat prices at Liverpool were 11 percent lower in the fourth week of October than in the period April 1 to April 15. Cotton prices for the fourth week of October compared with the level of prices for the first half of April were 44 percent higher at New York in terms of dollars and 45 percent higher at Liverpool in terms of dollars, but only 6 percent higher in sterling at Liverpool and 3 percent lower at Liverpool in terms of gold.

Broader effects on prices seemed likely to result from the gold-purchase policy adopted by the Government in October. This policy, by gradually increasing the price of gold, indicates an intention eventually to cut the quantity of gold in the dollar. It may not have any great effect for some time on livestock and dairy prices, which depend much more on pay rolls in this country than on foreign demand. Eventually, however, most of our raw-material prices should rise to the extent to which the gold in the dollar is reduced. It may take certain products a year, or even several years, fully to reflect the change. It is well to bear in mind the probability that the favorable influence of our monetary policy on the prices of cotton and wheat may not continue if foreign countries reduce the weight of gold behind their currencies as rapidly as we do. Currency policies may stimulate our exports temporarily but should not lead us to think that a world-wide demand exists for our surpluses, unless sufficient changes have been made in our tariffs to build up sufficiently increased foreign purchasing power.

Varied Response to Recovery Factors

As usually happens when the general price level is changing, different farm products varied greatly in their response to recovery factors. The average of prices received by farmers in October was 43 percent above the low point of the depression. At one extreme, wool showed a gain of 237 percent; at the other, beef cattle rose only 7 percent. Corn in mid-October was 106 percent above the low point touched on December 15, 1932, whereas hogs showed a gain of only 56 percent. Tobacco prices advanced over the relatively high prices of the previous year which were the result of a short crop. The exchange value of farm products in mid-October was 60 percent of the pre-war average, compared with 71 percent at the season's high point in mid-July. This decline from July to October reflected both a decrease in prices received by farmers and a continued increase in prices paid by farmers for commodities bought.

It should be noted, in connection with the advance in the prices of the things that farmers buy, that this advance included part of the gain in the prices of farm commodities. Rising grain prices during the summer obliged farmers to pay more for feed and for such foods as they purchase. Building materials, equipment and supplies, fertilizer, machinery, and other things used in farm production increased in price also; these things, however, include comparatively little raw material from the farm. In mid-October the

index of the prices paid by farmers for commodities used in family maintenance stood at 119, as compared with 99 in March. The separate index for the prices of commodities used in farm production was also 113 in October, as compared with 101 in March.

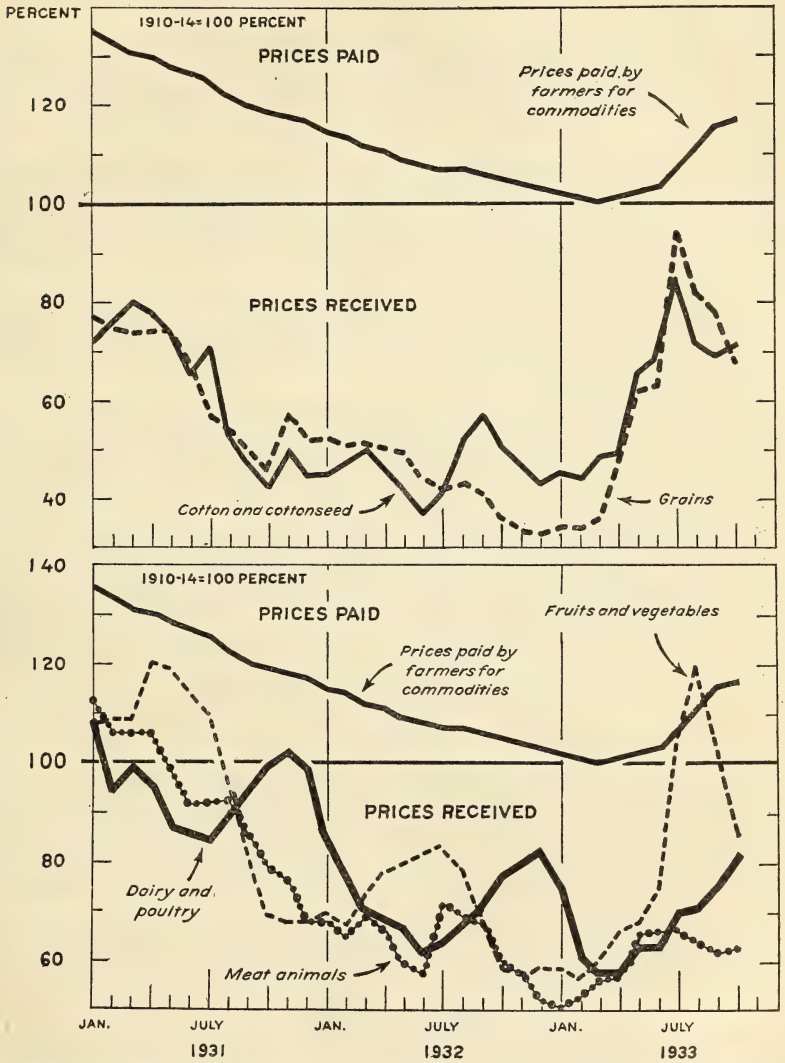

FIGURE 2.—Indexes of prices received and paid by farmers. The recovery efforts since March have brought about a sharp advance in certain farm products, particularly grains and cotton. The prices of these commodities had previously fallen to lower levels than the prices of most other farm products. They responded promptly in 1933 to the administration's monetary policy. Commodities more nearly on a domestic basis, such as meat animals, dairy products, and poultry products, did not rise equally as a result of monetary changes, but showed some advance. A small crop of potatoes caused a great advance in potato prices and raised the average for the fruits and vegetables group. The advance in prices received by farmers was partly offset by a 17-percent advance in prices paid by them. But returns to cotton growers and wheat growers were augmented by benefit payments for acreage reductions. These payments meant practically parity returns to the growers. Benefits to farmers during the 5 months from August to December were equivalent to a 20-percent increase over their cash farm income for the same period last year.

FARM REAL ESTATE VALUES

The total value of farm real estate in the United States fell from $37,027,000,000 as of March 1932, to $30,515,000,000 as of March 1933. These values compare with $47,880,000,000 in 1930 and $66,316,000,000 in 1920.

The acre value of farm real estate declined in nearly every region. The average for the United States, as of March 1933, was 27 percent below pre-war (1912–14), as compared with 11 percent below for the previous year. The peak of values, 70 percent above pre-war, was reached in 1920.

Present low levels are the result of two fairly distinct movements. The first lasted from 1920 to 1930. In that period, during which the effects of the speculative wave in the war and post-war boom were largely liquidated, the Department's index of land values dropped from 170 to 115, a decline of 32 percent.

During the second broad movement, which became clearly evident in 1930, the index declined from 115 to 73 in 1933, a decline of nearly 37 percent. This drop reflected the drastic decline in the price level during the depression.

The relative decline in farm real-estate values has been greater during the past 3 years than during the whole decade following 1920.

In only 7 States, 4 of them in New England, was the index of land values higher in March 1933 than in 1912–14; in some States it was less than 60 percent of the pre-war index.

In the Middle Atlantic States values averaged 82 percent of pre-war, in the East North Central States 62 percent, and in the West North Central States 64 percent. The index for the South Atlantic States was 80 percent of pre-war, for the East South Central States 79 percent, and for the West South Central 82 percent. Values in the Mountain States averaged 69 percent of pre-war and in the Pacific States 96 percent. The New England States, where the index was 105, were the only group in which average values were higher than in 1912–14.

Forced sales of farms increased as a result of delinquency on taxes and on debt service. For the year ended March 15, 1933, approximately 15.3 farms per 1,000 were sold for taxes. Approximately 38.8 per 1,000 were involved in transfers in settlement of debt. Corresponding rates for the previous year were 13.3 and 28.4 farms per 1,000, respectively.

These transfers of title are not necessarily final in every case, since periods of redemption are frequently provided by State statutes.

FARM DEBTS

One of the worst aspects of the farm problem is the farm-debt situation.

In 1928 farm-mortgage indebtedness in the United States amounted to nearly $9,500,000,000, and short-term indebtedness, represented chiefly by loans from local banks, ran to about $3,000,000,000 more. Farmers owed large additional sums to livestock-loan companies, farm-implement companies, and merchants. Total farm indebtedness undoubtedly exceeded $14,000,000,000. On the real estate indebtedness, the annual interest charge averaged about 6 percent.

On the short-term bank indebtedness the interest charge averaged probably 7.5 percent. On merchant credit the interest amounted to 10 or more percent. This Department estimated the annual carrying charge for 1928 at $900,000,000.

By 1932 the mortgage indebtedness had been reduced to about $8,500,000,000, and the total of other forms of farm indebtedness had declined also. Ordinarily, a reduction of indebtedness is a favorable sign, an indication that debtors are improving their financial position. Sometimes, however, it is an unfavorable sign. This is, in large part, the case with the decline of farm indebtedness in this country since 1928. It is largely a result, not of normal liquidation, but of foreclosures, bankruptcies, and forced sales, and of the inability of local banks and other credit agencies to lend. Forced sales in 1932 constituted 37 percent of all transfers, as compared with 27 percent in 1928. Moreover, the reduced carrying charge represents this year a much greater proportion of the gross farm income than did the larger payments in 1928. Mortgage carrying charges alone will take this year something like 13 percent of the gross farm income.

In 1932 for the country as a whole nearly 16 percent of all mortgaged farms were encumbered for more than 75 percent of their value. The mortgage debt represented 25 percent of the value of all farm land and buildings, and about 40 percent of the value of all mortgaged farms. It was two and a half times greater than in 1910. Even in 1929, before the depression, farmers had difficulty in meeting their interest charges and in retiring maturing loans. Even then they were not getting a fair exchange value for their products. When farm prices dropped in the depression to 50 percent below pre-war, payment became impossible for great numbers of farmers, especially those carrying heavy indebtedness.

Difficulty in Getting Renewals

Their plight, because of delinquency and lower land values, was intensified by an increasing difficulty in renewing mortgages at their original amounts. About 12 percent of the farm-mortgage indebtedness normally comes due each year. Delinquent interest and principal payments have automatically increased the number of loans for which payment has been called. Reduction of the total debt through foreclosures means that farmers are being forced to the wall. The need, in existing circumstances more than ever before, is for refinancing of mortgage debts pending a further improvement of farm income. Mortgage interest is in arrears on thousands of farms that have not yet been brought under the hammer.

The depression disrupted short-term credit facilities as badly as it did mortgage facilities. Country bank failures multiplied. After the general bank suspension in 1933, more than 3,000 banks, mostly in rural areas, failed to reopen or reopened only for restricted withdrawals. Deposits dropped in the banks that did not fail. In 20 leading agricultural States, the 4-year period ended in February last saw a decline of more than 50 percent in the net demand deposits of member banks in the Federal Reserve System in cities and towns of less than 15,000 population.

This summer there was a partial recovery, but the level of deposits still remained 14 percent lower than in the midsummer of 1932.

Low bank deposits mean low bank lending power. This may reduce farm production, but the method is bad. Many farmers cannot adequately carry on their farming operations when production credit fails.

Farm credit difficulties, though especially acute since 1929, did not begin then. Credit facilities have been inadequate in many rural areas for years. The Federal Government has attempted frequently since the war to improve the situation through emergency measures and new permanent agencies. In 1921 it enabled the War Finance Corporation to advance funds to livestock-loan companies and to banks in agricultural communities. In 1923 it established the Federal Intermediate Credit Banks. In 1929 it financed cooperative marketing organizations through the Federal Farm Board. In nine different years it provided money for seed loans. It authorized the Secretary of Agriculture to assist in capitalizing agricultural-credit corporations and livestock-loan companies and authorized the Reconstruction Finance Corporation through the regional agricultural-credit corporations to make direct loans to farmers on the security of livestock and other personal property including growing crops.

These various activities did not suffice, however, to meet the critical situation that developed as the depression continued. Accordingly Congress took additional action, along the lines previously described in connection with the passage of the Agricultural Adjustment Act.

It is not within the scope of this report to discuss the administrative side of the new Federal credit policy, because that is the responsibility of the Federal Farm Credit Administration. That body coordinates the credit functions of the former Federal Farm Board and also of the Federal Farm Loan Board, which has charge of the Federal land banks and the intermediate credit banks. Also it supervises the administration of the regional credit corporations and the various emergency-loan funds previously administered by the Department of Agriculture. Formerly these various Federal credit functions in many cases overlapped, and farmers often did not know where to apply for the particular kind of credit they needed.

By strengthening the capital structure of the Federal land banks and furnishing substantial sums for mortgage loans to farmers, Congress gave private lending agencies an opportunity to transfer loans which they could not hold, and thus to avoid foreclosing on the farm borrowers. It relieved farmers materially by authorizing the Federal Farm Credit Administration to reduce the interest rate on Federal land bank bonds, and temporarily to waive payments on the principal. In addition it made direct loans available to farmers in districts where local farm-loan associations are not in a position to accept loan applications.

It will take time to realize the potentialities of the new legislation in tangible benefits to the agricultural industry, but the ultimate showing should be very substantial. Already the foreclosure process has dropped off considerably.

New Credit Agencies

Under the 1933 credit legislation, the Farm Credit Administration may set up in each Federal land bank city two new credit agencies, a production credit corporation and a bank for cooperatives. The

production credit corporation may purchase stock in local credit associations which function as discounting agencies with the Federal intermediate credit banks. Borrowers through these associations will be required to buy stock in them. The cooperative bank may make loans to farmers' cooperative associations organized not only for the sale of farm products but also for the purchase of farm supplies.

Besides the 12 national cooperative banks, the Farm Credit Administration has set up in Washington, D.C., a central bank for cooperatives. This institution will make loans to the major cooperative associations about in the same manner as did the Federal Farm Board.

Banking Difficulties

More than a decade of serious banking difficulties in agricultural communities has made banking reform a problem of great importance to farmers. More than 10,000 banks have failed in the United States since 1920. In mid-August this year, about 2,800 banks were restricting withdrawals. Most of these banks were in agricultural communities. Such figures indicate the difficulties that farmers have had with their banks. The loss to both depositors and borrowers arising from bank receiverships has been tremendous, and the lending power of open banks has been drastically curtailed.

The trouble in country banks arose mainly from withdrawals by depositors and from a frozen condition of the loans and investments. These conditions, present as troublesome factors for many years, were greatly intensified by the depression. Growing disparities between income and necessary expenditures in agricultural areas caused deposit declines, which thousands of country banks, because of their frozen condition, could not meet. The depression rendered loans less collectible and depreciated the value of bonds to the point where, in many cases, banks dared not sell their bonds. Caught between these two millstones, thousands of country banks were forced to close or to restrict withdrawals. This created a condition of public distrust which further aggravated the situation.

Difficulties arising from the depression, however, would have caused far less widespread damage had not the banking situation already been weak. Studies participated in by the Bureau of Agricultural Economics show that before the depression set in numerous country banks had large holdings of poor loans and speculative bonds, and that most country banks were deeply involved in financing the long-term needs of farmers and businesses in their communities. They were able to do this because their time and savings deposits, added to their current deposits, gave them a lending power far in excess of the amount that farmers and local industries needed for current operating purposes.

Financing of this character does not usually reveal its weakness until depositors begin reducing their accounts. Then it becomes apparent that loans for long-term purposes cannot be collected except on a very small scale. If, combined with local withdrawals, there is a general depression of values which reduces the collectibility of loans and which impairs the values of bonds, banks often find it impossible to meet the demands of depositors.

Loans for the current operating purposes of farmers and business men can be discounted at Federal Reserve banks, even if they

are not immediately collectible; hence these loans are seldom responsible for the failure of banks. But there is virtually no outlet for most of the paper representing advances for the long-term purposes of farmers and local business men. Although many banks have successfully weathered the depression in spite of their large holdings of slow loans and depreciated bonds, few have been able to do so when local unrest has caused deposit withdrawals of very large extent.

Means of Strengthening Country Banks

A means of strengthening country banks is suggested by the fact that banks become deeply involved in long-term financing mainly because their lending power greatly exceeds the volume of credit that farmers and local business can absorb in liquid operating loans. This, in most banks, results from the large volume of their time and savings deposits. Were these accounts removed from commercial banks, such banks would be able to keep in much more liquid condition. Segregated in savings banks or loan companies the time and savings deposits would be a source of little difficulty, for these institutions could easily call a halt upon runs by depositors. The bank which handles both kinds of accounts cannot do this, because an attempt to restrict one type of deposit actually creates runs by other types of depositors.

Segregating the time and savings deposits in the manner indicated might seem to work an injustice upon the depositors, particularly if restrictions were placed upon withdrawals. It is obvious, however, that no considerable amount of time and savings deposits can be paid in a short period of time by any type of banking system. The funds representing these deposits are invested in the fixed capital of agriculture and industry, and cannot be extracted at short notice. Taking such accounts out of commercial banks would merely make it impossible for time and savings depositors to force a general banking collapse by attempting to withdraw their money.

FARM TAXES

Farm taxes per acre in 1932 were 89 percent higher than in 1913. This Department has completed a study to determine changes in farm real-estate taxes per acre and in relation to value for each of the 48 States. By 1929 the taxes per acre had risen on an average 141 percent above the pre-war year 1913. In every geographic division they had more than doubled.

Since 1929 acute distress among farm taxpayers has forced reductions in tax rates, in assessments, or in both, in all but three States. The average tax reductions, though substantial, have been very unevenly distributed among taxpayers. Many have had no reduction from the 1929 level. Indeed, in three States the averages have not decreased.

In 1913 taxes amounted to an average of 55 cents on each $100 of farm valuation. By 1929 the figure had increased to $1.19. In the second post-war depression land values fell more rapidly than did taxes, with the result that in 1932 farm taxes amounted to $1.50 per $100 of farm valuation, or nearly three times as much as in 1913.

Farms in ever-increasing numbers became tax delinquent. A great part of the delinquency followed the severe drop in farm prices and income in 1929 and later. A significant increase was evident, however, before 1929.

The tax burden on farmers results primarily from the undue reliance of State and local governments on the general property tax, from the discriminatory weight of this tax upon real estate, and from the relatively great amount of real estate required in a farming business. The so-called "general-property tax" is little more than a real-estate tax and falls with special severity on farm owners. Less reliance should be placed on the general-property tax as a source of State and local revenue, and the efficiency of rural government should be improved through a revision and redistribution of functions, and through a reorganization or consolidation of governmental units and of administrative machinery.

EXTENSION AND INFORMATION WORK

The extension services of the Department and the various States have been the spearhead of the educational effort to acquaint farmers with the purposes and opportunities of the various programs undertaken under the Agricultural Adjustment Act.

With experienced local farm agents in 2,200 counties, and other agencies at work in 700 other counties, the cooperative extension service was well organized to assume the advisory and informational responsibility. Special temporary agents were assigned to many counties with high agricultural production, to aid in the emergency work. Federal and State specialists and administrative staffs threw their efforts, backed by years of experience, into supporting the field agents in interpreting and instructing in the national programs of agricultural adjustment.

First of all, farmers were given the fullest possible information on current economic situations in agriculture. The disastrous results of great surpluses of wheat, cotton, hogs, and other basic agricultural products were outlined. Farmers gained a new understanding of the "shadow of excess." They caught the significance of closed export markets. They realized the vital need of adjusting production with effective demand.

Then came the first of the basic production reduction programs—the emergency plan which took more than 4 million bales of cotton from the potential 1933 crop. Supported by more than 20,000 volunteer workers, the extension staff in the South led the campaign in which more than a million cotton growers signed contracts to reduce their 1933 crop acreage. Fighting against time from the start, the entire campaign was pushed through in 6 weeks.

Working simultaneously in more than 30 States, the cooperative extension forces carried out the educational and organization features of the national wheat adjustment campaign, launched by the Agricultural Adjustment Administration as a 2-year production-control program. Wheat growers signed voluntary applications bringing more than 50 million acres of wheat under the agreements, which call for a 15-percent reduction in 1934 acreage. Extension representatives helped hundreds of local wheat production-control asso-

ciations, composed of the participating farmers themselves, to organize. These associations will carry out much of the local administration of the wheat plan.

In production-control campaigns for various types of tobacco in different districts, and in carrying out the emergency hog-marketing plan, the extension staffs performed field activities. In the more permanent cotton, dairy, and corn-hog adjustment programs, as well as in many more localized activities in the general campaign to restore the pre-war purchasing power of farm products, the widespread cooperative extension service has been in position to carry out the needed educational and organization work.

Home-demonstration agents, located in more than two thirds of the counties of the United States, have cooperated with the consumers' counsel of the Agricultural Adjustment Administration in helping the home makers of the country to meet changing economic conditions. They have done a great deal of work with local relief agencies, assisting with meal planning and dietary recommendations, encouraging home gardening, conducting food-canning demonstrations, and helping plan emergency budgets. The home-demonstration agents have also directed activities which have helped to keep families off the relief rolls. They have supported the live-at-home program, which has made it possible for many families to be largely self-supporting.

Even in the midst of efforts to solve great economic and social problems, the interest of the entire country, both rural and urban, in the 4-H clubs has been sustained. 4-H club membership and work have kept up their excellent records. Young people have, perhaps, been most keenly interested in ways to assist in the family's problems and in projects which promised some profit.

As details of commodity adjustment efforts were more sharply defined and the various phases were woven into a strong national agricultural plan, extension agents adapted their programs to carry on both the vital adjustment work and their regular responsibilities in helping to solve the ever-present problems that face the American farm family—reduction of expensive loss and waste in farm operations, better utilization of labor and facilities, economical improvements in quality of products, provision of satisfactory standards of living, and maintenance of the morale of the family.

Publications, Press, and Radio

Supplementing the extension efforts on the adjustment program, the information staff of the Department carried out the largest single, intensive effort it has ever made to unify the thinking and action of farmers. By issuing publications, by cooperating with the press of the country, and by broadcasting daily over 300 radio stations, the Department acquainted farmers with facts about current supply-and-demand maladjustments, prices, and possible remedies, and about the basic principles and powers of the Agricultural Adjustment Act. The purpose was to give farmers facts on which they could intelligently shape a program designed to improve their economic conditions and, acting in unison, use the centralizing power of the Federal Government to make that program work.

Machinery for handling information was reorganized. Previously the press work of the Department and of the State extension services was carried on more or less independently. During the early part of May arrangements were made to clear some of the Department's press material through the agricultural extension editors in the 48 States. Seventeen State extension services were already cooperating with the Department in correlating agricultural radio programs; this number was quickly increased to 41, thus providing an effective Federal-State channel for the daily distribution of information. Finally, a special information unit was established in the Agricultural Adjustment Administration to give the public each day accurate accounts covering actions taken and policies decided upon.

In previous years the principal function of the information staff was to interpret and place in the hands of those who could apply them, the facts and recommendations arising from the scientific, economic, regulatory, and conservation work of the Department. The new program does not supplant the other work; in fact, technical knowledge has become of increased importance to farmers and others. But greatest emphasis is now placed on economic and social adjustments which have a single purpose—increasing the buying power of farm commodities.

PLANT INVESTIGATIONS

Sugar Beets

Plant investigations developed strains of sugar beets resistant to leaf spot. Hybrids produced by intercrossing surpassed the commercial strains in tonnage and sucrose percentage. The introduction of these leaf-spot-resistant hybrids is now definitely forecast. For large areas in the Middle West they will provide a measure of relief against a disease which has in many seasons made crop production and factory operation unprofitable.

Curly-top-resistant variety U.S. No. 1, a recent development, proved superior to ordinary sorts in seasons when the curly-top disease was important and compared favorably with the best commercial varieties in seasons when curly top was unimportant. It produces a slightly lower tonnage but equals the commercial strains in quality. It will be distributed to growers for testing in 1934.

New Egyptian-Type Cotton

Comparative field tests under diverse conditions of climate and soil indicated that a new hybrid obtained by crossing Pima, the only variety of Egyptian-type cotton grown commercially in the United States, and Sakel, the most valuable of the varieties grown in Egypt, may be depended on to outyield Pima 20 percent. Spinning tests are being conducted to determine the value of this new hybrid in comparison with Sakel.

Downy Mildew of Tobacco

Laboratory studies indicated that although spore germination and plant infection can occur over a wide range of temperatures,

spore production takes place only with night temperatures between 50° and 60° F. Maintaining night temperatures at 70° gives effective control. In most localities the critical period over which such temperature control is needed probably does not exceed 3 weeks.

Barley—Oats—Wheat—Flax—Corn

Analysis of 5 years' yield from the entire United States and Canada shows that Trebi barley, introduced by the Department, has a remarkable range of adaptation. It was the highest yielder at 31 stations, no other variety leading at more than 4 places. It is not considered satisfactory for malting purposes, but is a high-grade feeding barley.

Bond, Alber, Berger, and Victoria oats recently introduced by the Department from Australia and South America are proving highly resistant to crown rust which seriously limits the production of winter oats in the South. The first three, moreover, show indications of being adapted to different sections of the South. Some very promising hybrids involving these varieties are being developed.

A new wheat variety, Yogo, developed in cooperation with the Montana Agricultural Experiment Station, is unusually winter hardy, resistant to bunt, and well adapted to, and high-yielding in, the northern winter-wheat section of the Great Plains.

Browning (*Polyspora lini*), a disease new to the principal seed-flax areas of the United States, was found in North Dakota in 1932. Bison, highly resistant to flax wilt, is very susceptible to the browning disease. Other commercial varieties appear to be quite resistant to it. Periods of low temperature during the early and late growing season seem to favor the spread of the disease.

Seed of parent lines of four corn hybrids, developed in cooperation with the Iowa Agricultural Experiment Station, has been placed with farmers for production on a commercial scale. In 1932 these four hybrids produced yields 14 percent greater than did the average of open-pollinated varieties grown in the Iowa corn yield test. They are markedly more resistant to lodging than the open-pollinated corn, and otherwise more valuable.

Crotalaria—Lespedeza

The use of crotalarias for soil improvement, especially in orchards of tung-oil trees and in citrus groves on sandy soils, has greatly increased because these plants are not infected by the root-knot nematode. This is of the greatest importance for any soil-improving crop for sandy land in the South as far north as the peach area of North Carolina. At least one species of crotalaria has been found useful for soil improvement as far north as the Ohio River, wherever the type of farming allows the use of a summer soil-improving crop. Other species have proved to be good forage crops.

Korean lespedeza, introduced by the Department in 1921, has now spread from the Atlantic coast to eastern Kansas, and in Missouri has reached such importance that new rotations are being built around it.

In cooperation with the Virginia Agricultural Experiment Station, the Department developed a number of stocks of Virginia-type

peanuts grading 85 percent or more of extra-large size. The stocks are also higher yielders than ordinary sorts. Since a substantial premium is usually paid for large-sized peanuts, these new stocks open the way to materially increased profits for growers.

The Department bred a new early variety of the Refugee-type bean which is decidedly resistant to the mosaic disease and which is attracting the attention of canners and seedsmen. It is about 2 weeks earlier than the Refugee and shows much promise for canning. Its earliness is important because the present commercial strains are so late that in many of the important bean seed-growing districts frost occurs before the seed is mature.

Some of the Persian walnut orchards of California were made to produce a profit for the first time the past year through a demonstration of the Department's discovery that artificial cross-pollination is sometimes necessary, not because of self-incompatibility but because the staminate and pistillate blossoms of the individual varieties do not reach maturity simultaneously in some cases. The cost of artificial pollination is low, about $3 an acre.

Handling and Transportation of Perishables

Investigations in the handling and transportation of fruits and vegetables showed that the quality of peas, baby lima beans, and sweet corn, which deteriorate rapidly after harvesting, can be maintained for several days by storage in carbon dioxide gas; and that soft scald and soggy break-down of apples may be prevented by treatments with carbon dioxide for 2 or 3 days prior to cold storage at 32° F.

The use of sodium acid sulphite mixed with the sawdust when grapes are packed has been found to prevent mold in storage of California table grapes. It preserves the grapes in sound and almost fresh condition for upwards of 3 months at 32° F. This chemical may be placed in the pad or cushion at the bottom of the package. Sodium metabisulphite may also be used.

Investigators worked out a new and more effective method of protecting pears from freezing in transit, which costs from $10 to $12 less per car than the old method. The latent heat of fusion of water can be employed to protect the pears from freezing. Sawdust saturated with water is packed under the lower portion of the load, and the heat liberated when this water is frozen in transit protects the fruit from freezing 2 days longer than does the use of dry straw or building paper.

Kieffer pears, the investigations showed, may be ripened to acceptable quality for dessert or canning purposes at a temperature of 60° to 65° F. This discovery is likely to prove of much importance to growers and to the eastern packing industry. The importance of proper ripening temperature for the Kieffer pear does not seem to have been realized heretofore.

Frozen-Pack Investigations

Frozen-pack investigations demonstrated that for fruit very rapid freezing is not only unnecessary but is sometimes detrimental to the quality of the product. With fruits packed in small retail containers,

the best quality in most cases, as well as the greatest economy in cost, is attained by freezing fruits at a temperature of 10° to 15° F. When the fruit is packed in barrels, a temperature of about zero appears desirable on account of the larger mass and the necessity of its being completely frozen before deterioration sets in. Expensive special equipment for very rapid freezing is not essential with this method of preservation. The facilities available in practically every cold-storage plant can be satisfactorily utilized. The limitations of this method are to be found in problems of marketing rather than in the use of any particular method of freezing. An air-tight container is essential for the satisfactory preservation of certain frozen-pack fruits.

Dutch Elm Disease

A serious outbreak of the Dutch elm disease was discovered near Newark, N.J., involving more than 200 trees scattered over some 600 square miles. Other infections were found on Staten Island and Long Island. In Ohio in 1930 and 1931 this disease was found on 8 trees which were immediately destroyed, and but 1 additional tree affected with the disease has been found during the past year in that State. A control program in cooperation with the State of New Jersey is being undertaken. As rapidly as possible this work will be extended to other States in which infection is found, in the hope of saving this important park and shade tree.

Stain in Pine and Hardwood Lumber

During the past 2 years over 200 pine and hardwood mills in the United States, Canada, Mexico, and the Philippine Islands have adopted the inexpensive organic-mercury treatment developed by the Department for the control of stain and mold in pine and hardwood lumber. Recent studies have added certain new chlorinated-phenol treatments which, though costing a little more, appear still more effective on all southern commercial species of pine.

ANIMAL-INDUSTRY INVESTIGATIONS

Much of the possible profit from hog raising in the South has been turned into loss by the kidney worm, the most widespread and destructive swine pest in this region. After many years of research on farms and at packing plants, the Department this year found a simple, practical, and cheap method of avoiding this loss which at the same time lessens the danger of spread of this pest to other parts of the country.

The method consists essentially in preventing the infection of young pigs, and in this respect is much like the original swine-sanitation system, which was also devised by the Department and which is now used widely by hog producers in the Middle West to control the roundworm. This new sanitation plan for southern farms depends on keeping the eggs and immature worms passed in the urine of the infected sows off the grass and other forage where they would be picked up by the young pigs in feeding.

Observation and a study of infestation of the soil have shown that most of the infectious material is passed in the area around the sleeping quarters and close to the fences. The eggs and immature

worms are soon killed by sunlight, heat, and drying. They cannot last long in the open unless they fall in grass or other plants. The plan, which has given good results in many farm tests, requires clearing away all vegetation, including grass and weeds, in a strip 3 to 5 feet wide along the fence on three sides of the pasture lot, and a strip about 30 feet wide at the end where the houses and other equipment are placed. These areas must be kept cleared while the pasture is in use.

Some few eggs and worms will be spread on the green part of the lot, but experience has shown that a very large percentage will be passed by the sows on the bare ground just outside the sleeping quarters, near the feeders, or along the fence. The actual results reported prove the point. In considering these results, it should be remembered that throughout a large part of the South at least 90 percent of the hogs are infested with this kidney parasite.

Near Moultrie, Ga., the Department investigators raised 125 pigs on pasture lots surrounded by these cleared sanitation strips. Only 4 percent of the pigs had worms in the kidney area, and only 15 percent of the livers were condemned at slaughter as unfit for human food, which means that 85 percent were not infected. Packing plants in this region have regularly lost about 95 percent of the livers as unfit, as well as parts of the loin, and frequently whole carcasses, all as a result of this parasite.

As a check on the lot of 125 pigs raised under the new sanitation-strip plan, 291 were raised under the original sanitation system used in the Corn Belt to control roundworms. Under this plan in the South the sows, before farrowing, are placed on a clean pasture and kept there with their pigs. The pastures in this system have no bare strips around the borders. A great reduction in infestation was the result, but it was not satisfactory. Of the 291 pigs raised this way and marketed, 23 percent had infected kidneys and 68 percent of the livers were condemned.

In addition, 28 pigs were raised in pasture lots with no sanitation measures before or during the pasture period. Thirty-two percent of them had infected kidneys, and 97.5 percent of the livers were condemned.

Bovine Tuberculosis

In the extensive Federal-State effort to eradicate bovine tuberculosis, three more States—Nevada, New Hampshire, and Utah—attained practical freedom from this disease during the last year. This brought the total number of such States to 11. Added progress in other States has increased the total number of counties accredited by the Department as free of the disease. On July 1, 1933, there were 1,626 counties, or 53 percent of all the counties in the United States, so recognized. During the fiscal year tuberculin tests were applied to 13,073,894 cattle and 255,096 were condemned. Funds made available for tuberculosis eradication by the various States and counties amounted to about $10,000,000 for the year.

In Iowa opponents of tuberculosis eradication attempted to abolish all legislation having anything to do with carrying on this activity. Public sentiment was aroused and the attempt was defeated in the legislature. The work is now going on in a satisfactory manner in that State.

Livestock Parasites

In the campaign to eradicate the cattle tick, the carrier of tick fever, the Department continued to cooperate with State and county officials and cattle owners in the affected Southern States. During the year Federal and State agents supervised 25,328,261 inspections or dippings of cattle, and 2,368,581 inspections or dippings of horses and mules. The following areas were released from Federal quarantine: 7 counties and part of 1 county in Arkansas, thereby freeing that whole State from quarantine; 6 counties and parts of 3 counties in Florida; and 10 counties and part of 1 county in Texas; the aggregate area released being 20,290 square miles. At the end of the year the Federal quarantine was limited to parts of three States—Louisiana, Florida, and Texas.

The Department in May 1933 removed the last of the Federal quarantines on sheep scabies. These quarantines at one time covered 2 million square miles in the Western States. The quarantines originally included North Dakota, South Dakota, Nebraska, Kansas, Texas, and all States west to the Pacific Ocean. Eleven of the States are now entirely free from sheep scabies. In most of the others in the range country there are only occasional cases, principally in feed lots where sheep come in from infected districts. The final eradication of isolated cases should not be difficult.

Investigations on the life cycle of horse bots showed the best time to treat horses and mules for the removal of these parasites. Essential facts with reference to poultry parasites, requisite to the formulation of control measures, were ascertained. Experiments developed a safe and satisfactory treatment for the removal of poultry ascarids.

Valuable New Disinfectant

As a further means of safeguarding livestock production the Department studied the chemical structure and effectiveness of various dips and disinfectants. The knowledge gained made it possible to standardize these products and make them more effective. Such studies recently led to the discovery that sodium orthophenylphenate is highly effective in destroying tubercle bacilli. The new germicide, which is now being made commercially, is especially suitable for use around dairy and farm buildings, since, unlike many other disinfectants, it has only a slight odor. It is readily soluble in water and is not severely poisonous to livestock.

Advances in Animal Husbandry

In animal-husbandry investigations the Department tested various promising means of producing livestock and their products more economically, while maintaining or improving their quality. Grazing investigations demonstrated that, while livestock do not produce so much from an acre of pasture as from an acre of harvested crops, pasture is the cheaper feed and returns the greater profit. Moreover, grazing conserves soil fertility better than when crops are harvested for sale or for livestock feeding. Other studies showed the high nutritive value of pasturage and the acceptable quality of meat produced wholly from grass-fed animals or those fed a combination of

grass and grain. A much greater use of grass in the Nation's program of livestock production seems desirable.

Record-of-performance studies with cattle and with swine disclosed wide variations among animals of similar breeding as to feed utilization and quality of carcass and meat produced. Certain sires appear to be capable of transmitting a high degree of excellence both in feeding efficiency and quality of meat.

The Department assisted producers in improving methods of home butchering and the care of meat. The meat program now includes 45 States in which county, State, and Federal workers assist farmers in home curing large quantities of pork, beef, and lamb. In Texas home butchering of hogs has increased 50 percent during the last 2 years. It is now practiced on more than 75 percent of the half million farms of the State. In Georgia 15,000,000 pounds of pork are now cured under refrigeration by farmers, much of it in cooperative, farmer-owned storage plants.

New Basis for Poultry Improvement

Studies on the inheritance of egg production, which is the key to improvement of poultry flocks, yielded highly valuable results. The number of eggs laid by a bird does not indicate the ability of that bird to transmit high production to its female offspring. Nor does the egg production of the sire's dam serve as a dependable index of the breeding ability of the sire. The most reliable means that is readily available of judging the value of a sire for a laying flock is the average egg production of his daughters.

The investigations disproved some common assumptions on which poultrymen have been culling their flocks and furnished a more reliable system. Neither the shape of a hen's body nor the shape of her head bears any relation to her egg production. A hen's ability to lay depends on her breeding rather than on any so-called "egg-laying type." Investigators measured the live birds, the dressed carcasses, and the bones of about 400 hens whose daily egg production had been determined by trap nesting. They could find no relationship between egg production or egg size and the shape of the hen's body. Similarly, the shape of the head, often regarded as an indicator of laying capacity, was not a safe guide. Head and skull measurements revealed no factor associated with high capacity for egg production.

DAIRY RESEARCH

Experiments to determine the relative production of dairy cows on a ration consisting of roughages alone as compared with a full grain ration continue to show that cows, when receiving a good quality of hay, are capable of fairly high levels of production at economical costs, without the addition of other feeds to the ration. Twelve cows at the dairy field stations have now completed yearly records, during which time they received no feed but alfalfa hay. They averaged 11,399 pounds of milk and 405 pounds of butterfat on a mature basis. These same cows have made comparable records on a full grain ration, averaging 17,769 pounds of milk and 602 pounds of butterfat. Thus the rather extreme ration of alfalfa

hay alone produced 64 percent as much milk and 67 percent as much butterfat as did the full grain ration. These results, together with data showing the comparative cost of producing nutrients in the form of grains and hays, indicate that the farmer who grows all the feed for his livestock will make more money if he grows and feeds all of the ration in the form of roughage, even with the lower production from his cows. This appears to be a practical method of slowing up the production of dairy products and at the same time increasing the profits of the producer.

Dairy investigators studying the factors associated with loss of natural green color in hay found that artificially dried hay having a low moisture content lost but little color when stored in the absence of light and air, and that there was no excessive loss of color when the hay was exposed for 8 months in either diffused sunlight or air or both. The naturally cured hays possessed less color and more moisture and when stored in the absence of air at room temperature sustained a marked loss in color. Samples of both the artificially cured and the field-cured hays stored in a refrigerator for 8 months retained their color exceptionally well.

Feeding experiments at two field stations showed a slower percentage decline in milk yield when cows were receiving a ration composed entirely of grass silage than when they were receiving a ration consisting entirely of field-cured grass hay. Cows show a marked preference for grass hay or grass silage made from grass cut at an immature stage of growth. The yield of milk also was greater on hay or silage made from immature grass. Cows can consume sufficient grass in green form, or as hay, or as silage, when cut at the right stage of maturity, and properly cured or ensiled, to supply sufficient nutrients for maintenance and a yield of 35 to 45 pounds of milk per day.

Shortcomings of Certain Roughages

Data are accumulating which show that certain types of roughages are deficient in factors essential to normal growth and reproduction. In cows this is evident in failure to breed and eventually, if the ration is not corrected, in death. Young calves fed on milk from such cows fail to develop properly and invariably die with the characteristic evidences of a vitamin A deficiency. This condition may be corrected by the addition to the ration of cod-liver oil or other recognized source of vitamin A. After 6 months of age calves are much less sensitive to this deficiency. These results emphasize the importance of the quality of the roughage in the ration of the dairy cow not only in protecting the health of the cow but also in providing for human nutrition a milk suitable for infant feeding.

Alfalfa hay of good quality is superior to good grass hay and very much better than low-grade timothy hay for supplying vitamin A, and pasture is much better than any combination of dry feed. The effect of pasture on the vitamin content of the milk is marked and persists for some time after dry feeding has been resumed. The yellow color of the milk fat, which has been found to parallel the vitamin A content, is three times as high on pasture as on dry feed.

Economic conditions which tend to depress the prices of the major dairy products increase the necessity for turning the byproducts of

milk into income-producing channels. The most important constituents of these byproducts are lactose and casein. In the past year dairy research workers have devised a method by which a grade of lactose satisfactory for technical purposes can be made with 1 crystallization rather than the 2 ordinarily required. This process permits the use of multiple-effect vacuum pans for concentration, thus still further reducing the cost of manufacture. It is hoped that through lowered cost the use of lactose for technical purposes may be extended. The work on casein has shown that the difficulty encountered by paper coaters caused by foaming of the casein-clay mixture can be controlled by a minor adjustment in the method of making the casein. By complying with a few fundamental principles a casein suitable for all requirements can be made in this country.

As a part of a Swiss cheese quality-improvement program, a Department specialist in cooperation with the State of Wisconsin carried on intensive educational work at a limited number of factories. This work included efforts to bring about the delivery to the factories of milk that has certain desirable properties as determined by well-known methods, examination of the starters with a view to approving them or recommending changes, and studies of manufacturing methods and other problems pertaining to the successful operation of the factories. By comparing the grades of the cheese made at the cooperative factories where this intensive work was carried on in 1932 with those made at the same factories the preceding year, it was learned that over $25,000 more was received for the cheese on account of the improvement in quality.

THE SOIL SURVEY

Results of the soil survey were utilized during the year in working out a basis for land classification in two States, the entire area of which had been surveyed. North Dakota used the soil survey as the basis for a comprehensive, exhaustive soil classification in a new land-valuation program designed to establish a fairer basis of taxation. The fundamental necessity for information supplied by the soil survey is obvious in connection with land classification, acreage retirements, and forestry, grazing, and other land-use problems.

The mapping of 27,771 square miles of agricultural lands in 29 States by the Bureau of Chemistry and Soils in the past fiscal year brought the total of land mapped and classified to date to more than 1,500,000 square miles or nearly a billion acres. The completed soil surveys of this vast area (greater than the combined area of Germany, France, and Great Britain) provide practical working maps and handbooks to assist many thousands of farmers in making the best use of their soils, and afford an inventory of national soil resources.

Study of the extremely fine portion of the soil known as the colloid showed that the plant-food storage capacity of the inorganic colloid in a soil depends not only upon its quantity but also upon its kind. This indicated that the colloid is the key to knowledge of the intrinsic fertility and behavior of great groups of soils. Data collected by the Department on the colloids of soils from all important farming regions of the United States will be of value in determining their proper utilization, whether for crops, for pasturage, or for forests.

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FERTILIZER INVESTIGATIONS

Fertilizer manufacturers are adding magnesium to their fertilizer mixtures largely as a result of soil-fertility experiments in the Department and in State experiment stations. These studies showed that lack of available magnesium in some soils may seriously decrease potato yields. Small quantities of magnesium sulphate on certain soils in Virginia increased yields nearly 50 bushels an acre.

In certain soils investigators discovered zinc deficiency. An ordinary galvanized water bucket provided the clue. It enabled the Department's scientists to discover the cause and make notable progress in devising a cure for the rosette disease of pecans. Rosette first alarmed eastern growers of pecans and caused the abandonment of hundreds of acres of pecans in Florida, Georgia, and Alabama. As pecan orcharding spread westward to Mississippi, Louisiana, and Texas, the disease appeared in western groves and proved a serious problem that baffled State and Federal research workers, threatening a crop which in 1929 and 1930 had a farm value of approximately $7,500,000 a year.

In the fall of 1931 when investigators were experimenting with dips and sprays as possible methods of control, galvanized-iron pails were used. By dipping rosetted leaves in a solution of iron sulphate they were able to prevent rosette on young leaves and to improve the condition of diseased leaves. Consequently they sprayed trees the next season with iron sulphate but were disappointed with results. Checking back on the analysis of the solution they had used successfully in 1931, the investigators discovered that zinc was one of several impurities present in small quantities. Then they recalled that when they had dipped the leaves a galvanized-iron pail had been used as a convenient container for the dip and conjectured that some of the zinc in the galvanic coating might have dissolved and displaced some of the iron in the solution. They tested solutions of zinc sulphate and solutions of the other impurities. The zinc sulphate solution was effective, the others were not. Zinc sulphate also has the merit of being a relatively cheap chemical, making it economically practical as a remedy.

Improvement in the eating and shipping quality of strawberries resulted from experiments on North Carolina soils typical of the strawberry-growing sections of the Middle Atlantic Coastal Plain. Fertilizers containing 6 percent nitrogen, 8 percent phosphoric acid, and 6 percent potash gave best results. Applications of quickly available nitrogen salts in the early spring gave berries with poor shipping qualities.

DEVELOPMENTS IN CROP UTILIZATION

The Department's ethylene treatment for coloring and softening fruit was carried out during the year for the first time on a commercial scale. Its use in softening pears for canning resulted in important savings. The average cost of sorting pears had formerly been between $1 and $2 a ton. The ethylene treatment, by uniformly softening the fruit, reduced this cost to less than 2 cents a ton.

At present most of the low-grade cull oranges are sold for less than cost of production and enter into direct competition with

higher grade fruit in the fresh-fruit market. Their conversion into orange juice will remove this cull fruit from the fresh-fruit market and extend the market for orange juice into locations less readily reached by fresh fruit. This is now feasible. Research in the Department showed that properly deaerated and flash-pasteurized orange juice will keep its fresh flavor for as long as 1 year under refrigeration at 35° F., and for shorter periods at ordinary temperatures. The addition of a small quantity of partly deterpenated orange oil enhances the flavor and extends the storage life of the product.

Work on fruit frozen under controlled conditions in the laboratory indicated a new approach to the detection of tree-frozen citrus fruit. Field experimentation when freezing weather strikes the citrus groves will determine whether this method can be applied practically. Immediate detection of frozen fruit, even before it leaves the groves, would be a double safeguard to the grower. It would prevent the cost of handling damaged fruit and the resultant demoralization of the fresh-fruit market and would enable the diversion of damaged fruit in bulk lots to byproducts plants for salvage before complete loss by spoilage.

About 40 American manufacturers are today making 80 different insecticidal products that contain rotenone or related products as a result of the Department's work showing the potency of rotenone as an insecticide and its complete harmlessness to man and domestic animals that may eat it.

The determination of the complete structural formula of rotenone last year by Department chemists and their present efforts to synthesize it are further steps toward its use as a substitute for lead arsenate in controlling the codling moth and other insect pests. The substitution of rotenone sprays for those of lead arsenate promises to save fruit growers the heavy cost of removing arsenical residues.

SOIL-EROSION STUDIES

Erosion studies at 10 regional erosion stations established facts in regard to the extent and rate of soil erosion, and developed methods of erosion control. Unrestrained soil erosion is rapidly building a wilderness of worn-out land in the United States. The wastage speeds up with the removal of the absorptive soil down to the less absorptive, more erosive subsoil. Approximately 35,000,000 acres of formerly cultivated land have been essentially destroyed for crop production; 100,000,000 acres of land now in crops have lost all or most of the topsoil; 125,000,000 acres of land now in crops are rapidly losing topsoil; and additional area is suffering from erosion in some degree.

Farmers operating on the 100,000,000 acres of denuded land are subsoil farmers, practicing bankrupt farming on bankrupt land whose productivity has been vastly reduced.

Methods of Erosion Prevention

Erosion varies enormously with soil character, slope, and rainfall. Thick-growing vegetation is one of the most powerful agencies of control. Practical measures call for extensive use of (1) trees

and thick-growing vegetation, as grass, clovers, lespedeza, etc., on the steeper slopes and the more erosive soils; (2) practice of those rotations which keep the land under the soil-saving crops a greater part of the time; (3) maintenance in the soil of a good supply of absorptive vegetable matter; (4) use of tillage operations that favor increased absorption of rain water, such as contour cultivation, scarification of the land, subsoiling (on some lands), and keeping the soil in as coarse physical condition as practicable; and (5) use of engineering structures, such as terraces and soil-saving dams. These are some of the fundamental facts about erosion which the Department's work and that of cooperating State agencies have established.

The significance of soil character in relation to the erosion problem can be illustrated by a single example. In 1931 red soil in the piedmont of North Carolina (one of the most extensive farm soils of the Southeast) lost 13 tons of soil an acre and 13 percent of the year's rainfall on a 10-percent slope, under cotton; whereas, the Shelby loam (the most extensive corn soil of northern Missouri and southeastern Iowa) lost 105 tons per acre and 28 percent of the rainfall on an 8-percent slope used for corn. The rainfall was about the same, yet the less steep highly erosive Corn Belt land lost eight times as much soil and more than twice as much of the rainfall. The practical information on the comparative erosivity of the most important soil types in each major agricultural region, gained from the Department's work at its 10 erosion stations, is highly valuable for the program of crop reduction by indicating how the land taken out of crop production can be protected from destructive erosion.

Soil-Erosion Control

Engineering investigations in the Department demonstrated the utility of broad-base terraces, level on permeable soils in regions of light rainfall but more generally with a longitudinal grade not exceeding 4 inches per 100 feet, and properly spaced. Tests on the soil-erosion experiment farms showed such terraces to be the most permanent and effective means of soil-erosion control for cultivated lands. They interfere little with the operation of farm machinery and hold the soil upon the fields for use of the crops. Only 2 to 5 percent as much soil is washed from the terraced areas on the experiment farms as from the similar unprotected lands. Some 15,000,000 acres of farm lands in the United States have been terraced during the past 15 years, largely in accordance with methods developed by Department engineers. The present rate of terracing is about 3,000,000 acres a year. Lands so badly gullied as to be abandoned for farming have been reclaimed by small dams of brush and poles, and within 3 years the fields have been plowed, planted, cultivated, and harvested, and the gullies practically obliterated.

FORESTRY

The developments of the last 6 months have given a tremendous stimulus to the forestry activities of the Department, and a new outlook on the future. This is partly due to the initiation of the emergency conservation work and the unexpected allotment of more than $60,000,000 for land acquisition and for national-forest improve-

ment and development work in addition to what the Civilian Conservation Corps is doing. It should be possible to accomplish within a short term of months what, as matters have gone in the past, could not have been completed within many years. Even more important is the prospect for comprehensively planned land use. Forestry and agriculture supplement and help each other and must be brought into a rationally adjusted balance that will make the most effective use, in the common interest, of the interlocking soil and water resources of the country as a whole.

The emergency conservation work was authorized by the Unemployment Relief Act, passed March 31. Three months later there were on the national forests 591 camps, each containing 200 previously unemployed young men from 18 to 25 years old who in the interval had been selected, assembled, made physically fit for work, and transported (in some cases 2,500 miles) to the designated locations. This was carried out under a Director of Emergency Conservation Work, with the Departments of Labor, War, Interior, and Agriculture cooperating.

On the national forests the Forest Service selected the projects and camp locations, provided work equipment and transportation, and supervised the field performance. It advised with and assisted the State authorities in planning and executing the emergency conservation work on State and private lands, except on parks, and had general supervision of this part of the undertaking. The number of these camps is 658.

The industrial recovery and public works legislation afforded a means of going still farther in providing for the improvement of the national forests.

Estimates of the Expenditures

Estimates of the expenditures which could be made to advantage within 2 years on projects that would qualify under section 202 of the act were prepared by the Forest Service and submitted to the Federal Employment Stabilization Board. The proposed transportation system will eventually require not less than 50,000 miles of road and some 45,000 miles of trail. For improvements other than roads and trails, the estimates for the 2 years aggregated $27,172,015. From the public-works fund provided by the act there was made available for the fiscal year 1934, $15,000,000 for forest highways, $10,000,000 for forest roads, trails, bridges, and related projects, and $15,982,745 for other classes of improvement, development, and protection work. The road and trail funds will be usable for maintenance costs as well as for new construction. Some additional funds are available under appropriation acts for the fiscal year 1934.

For more than 30 years the Government has been slowly equipping the forests with improvements necessary for protecting them, opening them up to full use, and putting their resources into better condition. When the western forests were first set aside they were merely great wilderness areas, without the most elementary requirements for their care and public use. Comprehensive and detailed improvement and development plans have long been prepared for every forest, to insure an orderly, if slow, advance. But the goal seemed indefinitely remote. Not only roads and trails were

needed but also works of construction of a wide variety (lookout towers, telephone lines, buildings, firebreaks, range fences, bridges, etc.), and such undertakings as reforestation, timber thinnings, and other cultural operations, range revegetation, measures to control insect epidemics, blister rust, rodent damage, erosion, and similar injurious factors, and resource and other surveys.

The Civilian Conservation Corps is busy on thousands of projects that embrace practically the whole field, even though the relatively brief period during which the corps will be available and other limitations inherent in the plan leave a vast deal more to be otherwise provided for. When in addition to what the corps is doing, the 2-year program now beginning to go forward through use of the National recovery funds is finished, the national forests will be greatly improved in their capacity for usefulness.

Supplementary Purchase Policy

The national forests, however, are an incomplete system. At first they could be created only where suitable public-domain lands happened to be available. They have never taken in all, even of these lands. Since 1911 there has been a supplementary purchase policy for building up national forests in the East. At the close of the last fiscal year the eastern part of the system comprised 42 units within which purchases were being made. Their gross area was not quite 15,270,000 acres, of which the Government owned a little less than one half. Progress had been brought to a standstill prior to March 4. By the Executive action which directed on May 20, that $20,000,000 of the funds made available by the Unemployment Relief Act of March 31 be alloted to this Department for additional land purchases for national-forest purposes, as a means of broadening the field for employing effectively the Civilian Conservation Corps, the whole situation was changed.

Up to September 1, the National Forest Reservation Commission had authorized purchases to a total of more than 940,000 acres of land, in 30 of the established purchase units, at a total cost of $1,763,964. This acreage is approximately one fifth as much as the total of the preceding 22 years since purchases began, and is almost twice the total in any previous full fiscal year. The Commission also approved the establishment of 13 new units, and extensive additions to a number of the old units, thus broadening the scope of the acquisition program by about 6,000,000 acres. This is a forward step of profound significance.

The national welfare demands a much broader Federal conservation program than that of the past to correct the manifold evil consequences of unchecked individualism in the handling of forest resources and to promote a properly balanced and efficient land use. The readjustments essential to the rehabilitation of agriculture will add materially to the area available for forestry. Private ownership of forest land is breaking down on a scale only partly indicated by the alarming spread of tax delinquency and land abandonment in many States, following removal of the timber growth. Current methods of forest utilization and the lack of adequate fire control have been adding rapidly to the area of idle land, and in addition

have been working progressive deterioration in the stands and productive value of by far the greater part of the privately owned forests not yet near abandonment. A great national effort is called for to stem the tide now running strongly in the direction of impaired forest resources and diminished opportunities for remunerative labor in connection with their use and perpetuation.

National Plan for the Forests

On March 27 this Department submitted to the United States Senate a report of the Forest Service prepared in response to Senate Resolution 175 (72d Cong., 1st sess.) and presenting A National Plan for American Forestry. The report stated:

> The Department fully endorses the conclusions reached, that public agencies should acquire 224 million acres of forest land, including a part of the agricultural land now available, and place it under management at the earliest possible date following acquisition. A considerable part of this land has or will come into public ownership anyway by reason of tax delinquency. The States and their local subdivisions should take over as much of this acquisition program as their resources permit * * *. It is believed that the resources of the States will be fully taxed to acquire and manage 90 million acres leaving 134 million acres for the Federal Government.

The proposed plan, however, went farther than the program of public-forest ownership and administration thus briefly indicated. It contemplated assumption by the private owner, with suitable public help, of a very substantial part of the national undertaking to obtain all of the benefits, economic and social, which the forest resources of the country are able to render under a wisely devised and rightly applied plan for their best use. The code for the lumber industry adopted under the National Recovery Act appears to open the door widely for an extremely important change in this part of the field, if the right kind of industrial leadership and action, together with public cooperation to the extent necessary, are forthcoming.

The code declares as one of its purposes "to conserve forest resources and bring about the sustained production thereof"; and the applicant industries have undertaken, "in cooperation with the public and other agencies, to carry out such practicable measures as may be necessary" to this end. But if the end is to be attained, a liberal Federal contribution must be made. Both a great public opportunity and a great challenge to public action are involved which must be met promptly and vigorously.

Regulated grazing on the national forests not only has conserved and in many cases increased the carrying capacity of the ranges but also has contributed markedly to stabilization of the western range livestock industry and to better and more profitable practices of livestock management. The grazing privilege is eagerly sought by large numbers of outside livestock growers for whom there is no room. The departmental policy has always aimed at a scale of charges for range use that would obtain a fair and reasonable return for the privilege, while protecting the industry and the individual users against unstabilizing forces and competitive pressure for the ranges. The primary objective has been to make the resource contribute to healthy economic and social conditions in the dependent communities and regions.

This has precluded a policy of opening the range to competitive bidding. However, rental values of comparable range lands in the same neighborhood have in the past been the basic guide in establishing the fee schedule. Extreme drought conditions in the West in the summer of 1931 and a very severe following winter warranted a 50-percent reduction in the 1932 grazing fees, as an emergency-relief measure, and deferred payment was allowed to December 1 in place of the usual advance payment. Last winter and spring range users pressed for a continuance of the reduction. The Forest Service studied the practicability of relating the fee to the market prices of livestock.

Recommendations approved on May 27 provided for a yearly adjustment of the basic rate in accordance with changes in the average price received by livestock producers in the 11 Western States. The amount of the adjustment will be determined by the ratio that this average price bears to the corresponding average price during the period 1921–32, inclusive, for cattle, and during the period 1921–30, inclusive, for sheep. The base rate to which the adjustment applies is the average national-forest fee in effect during 1931, which was 14.5 cents per head per month for cattle and 4.5 cents per head per month for sheep. The adjustment will be made for each year by raising or lowering this base rate in the same ratio that the average price of livestock for the preceding year bears to the specified periods. It has been applied to the present grazing season and has lowered the average cattle fees 37.6 percent and sheep fees 54 percent.

IRRIGATION AND DRAINAGE STUDIES

Profitable agriculture in a large part of the West depends upon irrigation, and for many years the Department has studied the economical use of irrigation water. Irrigation requirements involve the settlement of water-rights claims; the equitable apportionment of public water supplies; the engineering determination of the capacities of canals, reservoirs, and other irrigation works; the prevention of waste in the distribution and use of the water; and the determination of the area that can be irrigated from a known water supply.

All reliable data that could be obtained have been assembled relating to experiments in the water requirements of crops. Average irrigation requirements have been determined for 97 subdivisions in the 5 regions that comprise all that part of the United States west of the one-hundredth meridian. Publication of the results should benefit not only farmers but also legal, administrative, and engineering agencies concerned with the proper use of water in the irrigated areas of the West.

Land Drainage

Many drainage districts rated as financially sound under what were considered normal economic conditions cannot meet their financial obligations because of tax delinquencies. This condition threatens the landowners in those districts with loss of their farms and discourages efforts on their part to make even partial payments

to the holders of the obligations. In order to avoid complete loss of the investment, landowners and bondholders must cooperate in adopting plans for rehabilitation based on the earning power of the lands. Mutual sacrifice is necessary. Engineers in the Department worked out one method by which such financial difficulties could be settled in a plan of rehabilitation for one of the largest drainage districts in the United States. The drainage taxes to be paid by the landowners each year would be based on the crop yields and the prices received for farm products. Maintenance of the drainage works, in order to conserve the earning power of the lands, would be provided before determination of the amount available for payment on the bonds, and that amount would be accepted in full for the bonds due that year.

COTTON GINNING AND FARM MACHINERY

In order that the full inherent quality of the cotton crop harvested may be obtained by the growers, cotton must be properly conditioned and ginned. At the cotton-ginning laboratory of the Department, improvements in the design of seed-cotton driers have been made that simplify the construction and reduce the cost of these machines, besides increasing their effectiveness in conditioning the cotton for ginning. Some 45,000 bales of cotton were conditioned last season in commercial driers, using the process patented by the Department. The value of that cotton was enhanced 60 cents to $5 per bale above the cost of drying. Experiments showed, however, that the ill effects of rough harvesting methods cannot be entirely overcome by the conditioning and cleaning machinery now available.

The Department recently designed and constructed a combination planter and fertilizer distributor, with which experiments in fertilizer placement can be extended to include snap beans on bedded fields. A trash guide of new design was developed for corn-borer-control work. This covers crop debris with smaller plows than were effective previously. Improvements in methods of artificially drying freshly harvested rice, particularly by establishing proper temperatures and exposure periods, greatly reduced the cost of drying and at the same time bettered the quality of the product. A variable-depth attachment for cotton planters, developed to place the seed regularly from minimum to maximum planting depths, was covered by public patent. In many comparisons with uniform-depth planters, during two seasons, this device largely eliminated the necessity for replanting, and materially better yields were obtained. Manufacturers are adapting the variable-depth principle to planters for some truck crops.

INSECT-PEST CONDITIONS AND CONTROL

The grasshopper plague in the northwestern Plains States, which caused such heavy destruction of crops in 1931 and 1932, continued during the present season (1933), being especially severe throughout much of North Dakota and extending southward into central and eastern South Dakota, northeastern Nebraska, and westward over

eastern and northern Montana, with isolated or less severe infestations in some half dozen other Western States. In general this situation closely paralleled the predictions from the egg surveys made in the fall of 1932.

The outbreak of the last three seasons in the Plains States is unprecedented as to area and continuance and resulted from a gradual building up during 2 or 3 favorable years prior to 1931 of common types of Plains grasshoppers. In Minnesota and North Dakota grain and other crops were given very material protection by extended use of poison bait. Minnesota furnished bait to the cost of nearly a quarter of a million dollars for use of farmers, and from State, county, and other sources some $80,000 was similarly expended in North Dakota. The benefits of the fairly adequate use of baits in Minnesota in 1932 were reflected in 1933 in the great diminution of area in which grasshoppers occurred in destructive numbers. In North Dakota the control was not sufficient to prevent extended egg laying in the fall of 1932, and this was reflected in wide-spread grasshopper damage in that State the present season.

Mormon Cricket

The Mormon cricket, outbreaks of which have been effectively controlled in recent years, assumed a threatening status on the Fort Hall Indian Reservation in eastern Idaho in 1932 which, though fairly well controlled, carried over into 1933. By pooling the resources of the Indian Service together with the assistance authorized by this Department in the purchase of calcium arsenate and dust guns, a control campaign was carried out in cooperation with State agencies which prevented crop losses. The appearance of this insect, however, in other isolated areas in Idaho and its reappearance in northwestern Colorado indicates that trouble from it may again be expected next season.

Bollweevil

In the spring of 1933 the bollweevil outlook threatened heavy crop damage on the basis of the unusually large number of weevils entering hibernation in the fall of 1932 and the very considerable weevil survival, though small in percentage, into the spring of 1933. The excessive drought and heat in June and July over much of the cotton area greatly checked weevil development, and serious infestation has been spotted and limited to areas of more or less localized rains. A biological factor of much interest in relation to the weevil is the definite determination this season that a malvaceous plant, althea (*Hibiscus syriacus* L.), widely used in the South as a hedge plant and ornamental, may serve as a host of the weevil.

Pink-Bollworm Eradication

Measures directed against the pink bollworm in Texas, New Mexico, and Arizona, were highly successful in both the eastern and western sections of the formerly infested area. In the Salt River Valley of Arizona, no pink bollworms have been found since the 1931 crop. It was possible in September 1932 to remove the fumigation requirement that had been maintained as a condition for the

interstate shipment of cotton from that valley. The insect was also eliminated from seven counties of western Texas adjoining the southeastern portion of New Mexico. These counties were entirely released from quarantine regulation in the spring of 1933. Outside of Florida, the known pink-bollworm infestations in this country are now confined to the limited irrigated sections between the Pecos Valley of western Texas and the Safford Valley of Arizona.

Surveys around the Florida outbreak of the pink bollworm showed the presence of the insect in a few cotton fields in the northern part of the State in Alachua and Columbia Counties, in addition to the infested wild cotton of the southern section of the State. A vigorous eradication program is now under way using substantially the same methods that have been successful elsewhere. The Florida infestation is largely confined to wild cotton on the keys and along the Atlantic and Gulf coasts of the southern part of the peninsula. Infestation in wild cotton extended up the west coast from Naples to Tampa Bay, which is within 150 miles of commercial plantings. The wild cotton north of Naples has been eradicated, and excellent progress has been made in destroying the wild cotton in the southern part of the State and on the keys. Destruction of this wild cotton is important for the protection of the main Cotton Belt of the United States lying several hundred miles to the north. If an infestation in the wild cotton on the keys and in the southern part of the peninsula were allowed to persist indefinitely, the Cotton Belt could probably not be permanently protected.

The section which is subject to the heaviest damage from the pink bollworm is the Big Bend area of Texas. An energetic clean-up program was carried on in that area during the past winter to reduce the heavy infestation and limit the risk of its spreading.

The roller method of sterilizing cotton lint to prevent the spread of the pink bollworm was developed and applied commercially during the year. The operating cost of applying this treatment is 1 cent per bale, as compared to a cost of $1.25 to $2 per bale for fumigation, or $0.75 to $1 per bale for compression.

Beet Leaf Hopper

The growers of sugar beets in the important southern Idaho district centering at Twin Falls have come to have full confidence in determining their plantings on the basis of the predictions of the Department specialists on the type and volume of migration of the beet leaf hopper to be anticipated from the wild areas of winter hibernation and early season breeding. The studies of the pest have determined its migration in the fall to these wild areas and its breeding up in such areas to return, following the drying up of natural food plants in early summer, to the irrigated areas. Predictions of probable abundance or scarcity of leaf hoppers have now been correct over a period of 7 years, with the single exception of 1930. In that year the important migration came from an area in the Northwest from which no migration had previously been determined. The surroundings of this Idaho district are now fully covered by the annual fall and spring surveys, and the correctness of the warnings issued have been notable in the last 3 years (1931–33).

In the important beet-growing districts in the San Joaquin-Sacramento Valleys of California, similar studies of migration and breeding of these leaf hoppers have been made. In the last 2 years in these districts, a very promising type of control has been secured by spraying the leaf hoppers following their fall migration and concentration for the most part in grassy valleys or canyons surrounding the irrigated district. Such control has been carried out under the direction of this Department, following its initiation by important interests engaged in the production of beets and the manufacture of sugar.

Mosquito Control and Unemployment

The importance of mosquitoes as pests and as carriers of diseases of man and animals has made necessary the investigations of the habits and means of control of the many species involved. Drainage is one of the most effective and generally applicable methods of control. It is desirable to apply work relief to projects which will yield distinct public benefits, and therefore the possibility of utilizing the unemployed in drainage operations received early consideration. In such work a very large percentage of the funds expended go to hand labor. This fact, and the immediate, widespread and relatively permanent benefits derived from mosquito control, together with the proximity of serious mosquito conditions to centers of population where unemployed problems exist, highly commend this work. Some cooperative surveys of mosquito problems have been undertaken. Several States have made rapid progress in draining vast salt-marsh areas where myriads of mosquitoes have been produced heretofore.

Spotted-Fever Tick

The occurrence of the deadly disease of man known as Rocky Mountain spotted fever in the Eastern States has naturally focused attention on the ticks which transmit it. The American dog tick is the carrier of the disease in the eastern half of the country. This dreaded malady has appeared in nearly every State; hence the problem is truly a national one. Methods of reducing the dangers of infection have been developed as a result of investigations of the tick concerned. These consist of steps to avoid the attachment of the tick to man and the reduction of the tick population near habitations. It is important to prevent engorgement of the adult ticks on dogs and horses. This may be done effectively by applying certain insecticides, especially derris powder. The immature ticks develop on small wild rodents, such as field mice, hence the destruction of these animals is indicated, especially by exposing them to the attacks of birds and animals of prey. This can be accomplished by clearing out underbrush, tall grass, and weeds near homes and camps. The utilization of the unemployed in this work has been recommended to communities where the disease occurs.

European Corn Borer and Phony Peach Disease

Two domestic plant quarantines, one relating to the European corn borer and the other to the phony peach disease, were revoked during the year.

The lifting of the European corn-borer quarantine was necessitated by lack of available funds for its adequate enforcement. This action was promptly followed by the issuance of State quarantines by some 27 States against the 13 infested States. These State quarantines restricted shipments to a considerably greater extent than was the case under the Federal quarantine and threatened serious interference with the movement of corn and certain other host plants of the borer out of the infested area. The difficulty was solved by the inclusion in the Agricultural Appropriation Act of an item for the certification of such products to meet the requirements of State quarantines, and a Federal inspection service was set up in March to supply the demand for this type of certification. This action establishes a precedent in dealing with domestic plant quarantine problems and is a distinctly forward step in the prevention of spread of plant pests, without undue hardship to the general public.

The anticipated heavy increase in damage by the European corn borer in the Great Lakes region did not develop. Such increase of population and damage was predicated on the unusually heavy larval populations successfully passing the winter in cornfields. However, unfavorable spring and early summer conditions so delayed planting and development of the corn in this one-generation area that when the moths emerged, the corn was too small to be attractive. In addition to this, the egg-laying period coincided with unusually hot and dry weather, resulting in the killing of many of the egg masses shortly after deposition. The field counts to determine the actual status of corn-borer population will not be available until October, but the indications point to no increase in this area.

The phony-peach-disease quarantine was canceled in March, as the discovery that the disease occurred over much more extensive areas in the South than had previously been known indicated that its further spread could be handled more satisfactorily by improved and modified nursery inspections in the various States than by the enforcement of a Federal quarantine. Department investigations point strongly to the peach borer as the carrier of the disease, and the prevention of spread of infection will now be undertaken by the various States through the inspection of the environs of peach-growing nurseries and the elimination of peach-borer infested or injured stock. The Department will continue to aid in the eradication of the disease and in the development and adoption of improved culling practices by the various State nursery inspectors.

Insecticide Residues

The presence of excessive amounts of spray residue found on deciduous fruits and vegetables moving interstate, and the increasing demand of consumers that such products be free from harmful residues placed added emphasis on the problem of controlling insects attacking deciduous fruits and vegetables. It stressed the need of using methods or materials that would eliminate or reduce injurious residues on the product when it appeared on the market. The Department reviewed the standard methods used for the control of insects attacking deciduous fruits and vegetables and issued circulars containing recommendations for the control of a number of impor-

tant pests. The revised recommendations placed special emphasis on the time and method of applying insecticides and urged the use of supplementary controls such as sanitary and cultural practices. Revised schedules for the control of insects on vegetables and small fruits, such as strawberries and blackberries, eliminated the use of arsenate of lead and restricted the other arsenicals to plants in such stages of growth that they do not reach the market.

For the control of insects attacking deciduous fruits it was recommended that the use of arsenate of lead be restricted as far as possible. For the control of the grape berry moth, the most important pest of the grapes produced in the eastern area, it was recommended that calcium arsenate be substituted for lead arsenate. The spray schedules for the control of the codling moth suggested the use of calcium arsenate with lime and a sticker or nicotine sulphate and mineral oil during the latter part of the season and, where many sprays were necessary, emphasized adequate washing prior to consumption or marketing.

DIET INVESTIGATIONS

Plans for adjusting agricultural production to consumption should include the utilization of foodstuffs by the family in the home, which, after all, is the part that means most to social welfare. Although we may now be the best-fed nation on earth, despite various shortcomings, yet there is still much room for improvement. We can practically wipe out rickets, pellagra, and other ills that come from faulty nutrition. We can build up the national health through better food habits and prevent many diseases which are hastened if not actually caused by wrong choice of food. The goal is optimum nutrition.

The first step is to produce the right kinds and the right quantities of foods so that people on farms and people in cities may have a well-balanced diet. At the same time the Nation must have facts about diet in relation to health, the standards of good nutrition, and the guiding principles in selecting a diet that promotes and safeguards health. Families need information on how to get such a diet with the amount of money they have to spend for food.

This year the home economists of the Department finished drafting master diet plans to furnish such a guide. These plans translate the scientific facts on food values and nutrition into specific quantities of foods on a two-way basis, nutritive content and cost.

Four typical diets at four levels of cost are included: A liberal diet when there is plenty of money to spend on food; a moderate-cost adequate diet; a minimum-cost adequate diet; and a restricted diet only for emergency use, such as relief agencies in many localities were forced to follow during the economic crisis. Some relief agencies, fortunately, were able to hold to the next higher standard, the adequate diet at minimum cost which provides a wider margin of safety, and this the Department counseled them to do wherever possible.

Each of these plans gives the quantity of foods needed yearly per capita on the basis of our population according to the 1930 census. Starting with pounds of flour and cereals and quarts of milk, the list gives definite quantities for each group of foods as delivered to

the consumer's door. For example, on flour and cereals it runs: Liberal diet, 100 pounds; moderate-cost adequate diet, 160 pounds; minimum-cost adequate diet, 224 pounds; restricted diet for emergency use, 240 pounds. Incidentally, this brings out also the important place the cereals fill in the lower cost diets.

In these per capita figures little allowance could be made for waste by the consumer or wastes in distribution. Waste in the kitchen is very difficult to estimate. What one household considers thrift another calls willful waste, and beyond question much good food is thrown away in public eating places. In converting these per capita figures into crop-production guides, suitable margins must be added to cover losses in harvesting and grading, deterioration in transportation and storage, and so on to final retail distribution.

Needs of Individuals and Families

Next, these pattern diets break down into quantities of foods for individuals and for families of different make-up. The nutrition experts find that, after 4 years of age and through adolescence, boys and girls need different quantities of food. An active growing boy generally needs the most food when he is 15 to 18 and a girl when she is 13 to 16. The boy in his teens has a right, it seems, to eat the family out of house and home. Adults differ also in their food needs depending on whether they are men or women and whether they have indoor jobs or do strenuous out-of-door work. These diet plans recognize all these widely different food needs of persons from babyhood to adult age and work them out in terms of pounds, quarts, and dozens of standard foodstuffs. So practical and so definite is the information that an extension worker can sit down with a farmer and his wife and help them make out a food budget for the year ahead, telling exactly how much of each kind of food they need to grow at home and how much they will have to buy in order to keep the family well nourished. Or a social-welfare worker advising a group of city women can help them draw up market lists to suit their incomes, never forgetting what this food means to family health.

Figured on the basis of 1931–32 retail prices, these four pattern diets range from $61 to $165 per capita per year. Or, worked out another way, it took, on the 1931–32 price level, $79 to buy a restricted emergency diet for a very active man and $215 to provide him a liberal diet. The minimum-cost and the moderate-cost adequate diets fall in between. The constant shifts in food prices make these cost figures of value only for purposes of comparison. Furthermore, they do not allow for the personal element in buying. Some housekeepers are shrewder shoppers than others. Given the same sum of money and the same market list probably no two women would go out in a city market and buy exactly the same foods. So when the food economists fix an average price on a diet, they do not expect it to be taken too literally. Some shoppers will beat the average and get more for their money; others will always fail to pick up the bargains.

The lowest diet is included only for emergency use, as during the years when unemployment took many families down to bedrock and below. It is not what dietiticians would ever recommend from

choice. But it does show how to lay out a meager amount of food money to get the greatest return in nutritive value. It represents quantities of food, especially protective foods rich in minerals and vitamins, below which no diet can safely fall. Relief workers and others cooperating in this plan for a low-cost diet helped many families to weather the crisis without permanent damage to health. The adequate diets at minimum and moderate cost recommend freer use of milk, vegetables, fruits, lean meats, and eggs. They appeal more to the appetite, and they furnish a generous margin of safety on the nutritive side. The liberal diet at the top of the scale will promote better-than-average nutrition.

In cities many families of skilled wage earners and well-to-do business and professional men spend enough money to serve this liberal diet on their tables regularly, but probably relatively few select food which has so high a nutritive value. Certainly far too few farm families have food that reaches this high level. A survey of a group of farm and village families in what is normally a prosperous part of central New York State showed that while their food had a money value somewhere between the minimum- and moderate-cost adequate diet mentioned, the diets of more than two thirds of the families were not adequate nutritionally as judged by our present standards.

GAME CONSERVATION

Critical conditions exist in waterfowl-breeding areas in the northwestern part of the United States and in the prairie Provinces of Canada. The numbers of the birds, vastly important for food and as a recreational resource, have been reduced by severe droughts, land settlement, and steadily increasing pressure from hunting throughout their ranges. Hundreds of observers from the Arctic Ocean to the Mexican border made reports to the Bureau of Biological Survey on local situations. At 50 bird-banding stations supervised by the Bureau, more than 31,000 ducks and geese were banded to determine accurately their principal stopping points and their routes of travel. Biologists in the Department studied conditions during both the southward and northward migrations, and on the chief winter-concentration and feeding areas of the birds. The information thus obtained afforded a basis for regulations governing the protection of waterfowl and the hunting privileges that may be permitted under the Migratory Bird Treaty Act.

Following the droughts of 1929 and 1930 observers noted that eelgrass, an important salt-water food for wild fowl, was seriously affected throughout its entire American range and was disappearing. That the cause was not directly traceable to the drought was shown by available records of similar trouble in other parts of the world. Drought conditions, however, by altering the saline content of the water supporting stands of eelgrass, probably favored the destructive agent, which is probably a bacterial disease. Eelgrass normally is the most important food plant of the brant and to a considerable extent of certain other wild fowl and is utilized also as an article of commerce. The greatly reduced supply was accompanied by an alarming decrease in the numbers of brant, estimated in some localities to be as much as 90 percent. As a result

of these findings, the brant on the Atlantic coast are given complete legal protection during the coming year, by amendments to the regulations under the Migratory Bird Treaty Act.

Migratory Bird Refuges

On May 29 the President approved the establishment of Civilian Conservation Corps camps at the Blackwater Migratory Bird Refuge, Md., the Swanquarter Migratory Bird Refuge, N.C., and the St. Marks Migratory Bird Refuge, Fla. These refuges were acquired by the Department under the Migratory Bird Conservation Act of 1929 and have been under administration of the Bureau of Biological Survey for about 2 years. With the aid of the Conservation Corps extensive developments at each refuge will include the construction of roads, trails, fire lines, and look-out towers, and of dams to create fresh-water ponds for wild-fowl food production. These improvements will greatly facilitate the administration of the several areas and materially improve their value in wild-life conservation.

In the 4 years since the Migratory Bird Conservation Act went into effect the Migratory Bird Conservation Commission has authorized the Department to acquire by purchase 137,664 acres for refuge purposes. Throughout the 48 States 141 proposed refuge sites, aggregating 3,710,927 acres, have been examined and appraised by the Bureau of Biological Survey under the provisions of the act, and 22 refuges have been created in 17 States and Alaska, at an average cost for lands purchased and in process of purchase of $4.57 per acre. There also have been taken 936,687 acres by Executive order, 2,033 by gift, 12 by act of Congress, 1,944 by lease without option to buy, and 6,343 by cession, bringing the total to 1,084,683 acres. The increase of 830,130 over the acreage under jurisdiction last year is largely through the establishment of the Boulder Canyon Wild Life Refuge of 659,130 acres, superimposed on the area for the development of the Boulder Canyon water power project, and the withdrawal of 135,184 acres of public lands in central Nevada, where additional studies will be made to determine their ultimate refuge value through the development of water resources. Progress on establishing the Cheyenne Bottoms Migratory Bird Refuge, Kans., has ceased for lack of appropriations to carry out the intent of the act authorizing it.

Fur Farming

American fox farmers harvested 150,000 silver-fox skins during the season 1933 and disposed of the bulk of them at prices that under prevailing conditions were considered very fair. An early European demand for American silver-fox skins saved marketing boards and auction companies from disposing of pelts at ruinous prices. Financially the fur-farming industry has been in good shape and the average fur farmer has had no heavy encumbrances. Bank closings, however, created problems in financing the feeding and care of the young foxes that were to provide this year's crop of fur. The Bureau of Biological Survey assisted fox farmers and their organizations in presenting their case to governmental agencies as an enterprise deserving financial aid to carry them over the critical period.

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A general wave of buying during June and July advanced prices on the fur markets as much as 60 percent, the average being about 25 percent. Shippers and dealers were more optimistic than in 1932. The fur industry caught up on some of its back indebtedness and liquidated large quantities of skins at a profit.

AGRICULTURAL EXPERIMENT STATIONS

The Department, through its Office of Experiment Stations, administers the Federal funds appropriated for the State agricultural experiment stations and for the experiment stations in Alaska, Hawaii, and Puerto Rico. During the fiscal year ended June 30, 1933, the Federal funds involved included $4,320,000 for the State experiment stations and for the experiment stations in Alaska, $64,000 to Hawaii, and $78,560 to Puerto Rico, or a total of $4,477,560.

The Department coordinates its work with that of the experiment stations to prevent unnecessary duplication and to adapt it to the varying conditions and needs of the several States and Territories, as well as to the Nation as a whole. More than 1,000 formal projects and a number of informal undertakings are now in progress, with a steady improvement in the cooperative work and relationships. The experiment stations necessarily have to deal with a wide range of local conditions, needs, and problems. They have an exceptional opportunity to extend and make more effective the work of the Department as a national research agency. Some recently reported examples of station work will show that the experiment stations, while highly responsive to local needs and problems, are also alive to the larger questions of national policy.

Soil Surveys in Forestry

Illinois has plans well under way for two national-forest units involving 599,232 acres in southern Illinois. These plans would be less advanced but for the soil survey. Facts collected in the survey were used for blocking out the two units. If these national-forest units materialize, they will be included in the national reforestation program and will employ hundreds of men. They will take thousands of acres of marginal and submarginal land out of production. This will relieve the counties and the State of maintaining roads and schools in the area. The money that the counties will receive from the forests will far exceed what they would have realized from taxes.

New Uses for Idle Acres

Reduction of farming in Massachusetts has resulted in many idle acres. Although a considerable amount of the area may be taken up for part-time farming, recreation, and residential uses, the major part must be utilized for the growth of trees. The Massachusetts Agricultural Experiment Station urges increased use of the lands for recreation and forestry. Much of the idle land is well suited for pasture. Stony upland pastures, the Experiment Station has shown, can be profitably improved with a relatively small outlay for fertilizers.

Revising Taxation Systems

Results of considerable social and economic importance resulted from taxation studies reported by the South Carolina Agricultural Experiment Station. These studies furnished the basis for discussion of tax reform during the 1933 session of the State Legislature. Farmers as a group are overtaxed. Until these studies were made, however, there was no basis, as far as South Carolina was concerned, for proper legislation. The findings of the Station, it is believed, will bring about a reorganization of the system of taxation to the advantage of the State and of its farmers. The Louisiana Experiment Station made a study of taxation in that State, which it is believed will serve as a guide in revising the tax system. Research by the Pennsylvania Station furnished the basis for a proposed revision of tax laws.

Improving the Quality of Cotton

South Carolina and other Southeastern States until recently failed to produce cotton of the quality demanded by the mills. A survey by the State experiment station showed that the mill requirement is largely for cotton fiber ranging from $\frac{15}{16}$ to $1\frac{1}{16}$ inches in length, but that the mills were able to get only about one fourth of their needs in the State. Through variety tests, fiber studies, and spinning tests the Station showed that cotton of the desired quality could be produced in any part of the State at no greater cost than the short-stapled poorer quality commonly grown. As a result of recommendations based on these findings, the production of cotton of the staple lengths desired increased from 38 percent of the total crop in 1928 to 75 percent of the crop grown in 1932. This change represented, even at depression prices, an increased income to the farmers of the State of more than $600,000 annually. The mills are now getting nearby practically all the cotton they need of the staple lengths mentioned.

Mineralized Milk

Milk is widely recognized as more nearly a complete food than any other single item common in the feed of animals or in the diet of human beings, but it has never been possible to rear experimental animals from weaning to maturity on cow's milk alone. After a few weeks on an exclusive milk ration, the animals lose in weight and die of anemia. The inability of milk to produce the necessary hemoglobin in blood has been attributed to its low iron content. The Wisconsin Experiment Station demonstrated that milk is deficient also in copper and that copper is indispensable in the nutrition of mammals. It is required as a supplement to iron in the formation of hemoglobin, and adding inorganic iron and copper salts to milk will prevent anemia. The station proved also that the addition of traces of manganese to a diet of cow's whole milk supplemented with iron and copper had a favorable effect on growth and reproduction. Pigs made greater growth on the mineralized milk alone than on a standard mixed ration, and rats grew and reproduced normally through four generations on an exclusive diet of mineralized milk.

Snow Surveys for Forecasting Water Supply

The amount of snow on the mountains is a matter of the greatest concern to farmers and stockmen, as well as to municipalities and power plants, in regions of deficient rainfall, because it is the measure of the water supply for the coming season. Snow-survey methods perfected by the Nevada and Utah Experiment Stations furnish a practicable means of measuring the snow cover and predicting the available water supply. The high watersheds of Utah are covered with a network of snow-survey courses, which serve as a basis for determining the run-off for each watershed and forecasting the stream flow. Wide practical application for this purpose has been made of the snow-cover survey methods.

FOOD AND DRUGS ACT

The original purpose of Congress in enacting the Federal Food and Drugs Act, namely, to safeguard the consumer against the sale of adulterated and misbranded foods and drugs and thus to protect the public health and pocketbook, has never been altered. But, for more than 15 years, Department officials have recognized that the law has definite limitations. It does not take into sufficient account the vast change in conditions which has come about in the food and drug manufacturing industries since the law was passed in June 1906. The Department has repeatedly advocated legislation to bolster up the weak points.

The Department's urge for a strengthened bill culminated, during the fiscal year, in the introduction in Congress of a completely new food and drug law designed to supplant the existing measure. This bill, Senate 1944, introduced by Senator Royal S. Copeland of New York on June 12, was prepared in the Department of Agriculture by direction of the President and with the active cooperation of the Secretary and the Assistant Secretary of Agriculture. Before it was introduced, the measure received the approval of the Department of Justice. It preserves all of the good features of the present law.

Among other things the new bill contains the following provisions:

Cosmetics, hitherto not covered by the Food and Drugs Act, are brought under regulatory authority.

Mechanical devices intended for curative purposes, and devices and preparations intended to bring about changes in the structure of the body are included.

False advertising of foods, drugs, and cosmetics is prohibited. The average consumer is guided far more by claims made in advertising copy than by the necessarily modest declarations printed upon labels of goods shipped in interstate trade.

Definitely informative labeling is required. The present law, insofar as labeling requirements are concerned, is very largely negative. It specifies that labels must be truthful but requires a minimum of information.

A drug which is, or may be, dangerous to health under the conditions of use prescribed in its labeling is classed as adulterated, and therefore illegal. This provision will prevent the indiscriminate marketing of drugs which should be administered only under careful supervision and control.

Promulgation of definitions and standards for foods which will have the force and effect of law is authorized. Without such standards it is extremely difficult for the Government to establish in court, before a lay jury, violations involving adulteration or misbranding of foods.

The prohibition of added poisons in foods, or the establishment of safe tolerances thereof, is provided for. Many food plants may at one stage or another in their growth develop or be contaminated with poisonous substances. Where the presence of poisons is unavoidable, the quantities of the injurious ingredients must be kept so low that by no possibility will the food be harmful. Under the new bill the Secretary will have authority to establish safe tolerances for injurious ingredients and to prohibit interstate traffic in foods which contain poisons in quantities exceeding the tolerances.

The operation of factories under a Federal permit is provided where protection of the public health cannot otherwise be effected.

More effective methods are provided for the control of false labeling and advertising of drug products.

More severe penalties for violations, as well as injunctions in the case of repeated offenses, are prescribed. The low penalties provided in the present act are inadequate to check first or repeated offenses.

Enforcement of the Law

Enforcement of the Federal Food and Drugs Act necessitated the initiation during the year of almost 3,000 legal actions against adulterated or misbranded foods and drugs, or their manufacturers. As in the past, the Food and Drug Administration concentrated its efforts on offenses involving public health. The Administration continued to devote from one fourth to one third of its appropriations to the control of interstate shipments of fresh fruits and vegetables found to carry residues of poisonous sprays, such as lead and arsenicals. Two hundred and forty-one seizures of fresh fruits and vegetables which carried injurious residues of poisonous chemical sprays were made, and 32 prosecutions of shippers of such commodities were instituted. The commodities seized included cauliflower, celery, lettuce, cabbage, pears, apples, and crab apples.

During the shipping season, members of the Food and Drug Administration spent literally night and day taking samples from the enormous traffic in fresh fruits and vegetables moving from producing points to marketing centers. Products other than fresh fruits and vegetables also were found to contain potentially injurious residues of arsenic or lead. Among these products were vinegar and apple pomace, chops, and pulp. The Government seized and destroyed 72,000 gallons, or one tank car, of vinegar which was adulterated with arsenic. In the survey of products made from fruits sprayed with lead arsenate, the Administration caused the seizure, in 1 month, April, of approximately 5,500 bags of adulterated apple pomace. The food was shipped by producers in towns in Pennsylvania, New York, Missouri, Michigan, and Washington to consignees in various parts of the country. The pomace was found to contain residues of arsenic or lead, both poisonous.

Spray-Residue Removal

It is necessary for growers to use chemical sprays in order to control the ravages of insect pests. Lead arsenate, calcium arsenate, and other chemical combinations have been found to be effective in destroying insects which prey upon crops. The grower, in order to obtain a crop at all, must use sprays, some of which are potentially injurious to the health of consumers. But the Department's duty to the public in the enforcement of the pure food and drug law necessitates rigid checking of all shipments of fresh fruits and vegetables which contain such residues of chemical sprays as may be harmful to the consumer. Proper cultural practices, in the production of fruits and vegetables, combined with careful washing of the commodity before marketing, are effective in removing spray residue.

In regulatory control over interstate and foreign shipments of adulterated or misbranded foods, drugs, and stock feeds, the Department seized 1,195 consignments of foods, 416 shipments of drugs, and 13 stocks of stock feeds. The year's prosecutions of manufacturers or shippers totaled 638 for foods, 453 for drug products (including livestock remedies), and 62 for stock feeds. Drug seizures included 74 consignments of livestock remedies which were adulterated, misbranded, or both, and 16 prosecutions were instituted in the case of livestock-remedy shipments. The year's grand total of all prosecutions and seizures of foods, drugs, and stock feeds was 2,777.

Seizures covered a wide variety of adulterated or misbranded foods, including short-weight butter, partially decomposed fish and sea food, fresh fruits and vegetables which carried residues of poisonous chemical sprays, and many other products. The Government also removed from the market, by seizure, a large variety of patent or proprietary remedies, falsely and fraudulently labeled as being effective in the cure of such serious diseases as tuberculosis, pneumonia, diabetes, venereal disease, Bright's disease, cancer, and other maladies.

FEDERAL-AID ROAD CONSTRUCTION

Projects involving the improvement of 13,255 miles of the Federal-aid highway system were completed during the fiscal year with Federal assistance. On 8,503 miles the work consisted of initial improvements, so-called because it was the first to be carried out with Federal aid on this particular mileage. On 4,700 miles previously improved with Federal aid to some extent, the years' work raised the condition of the roads to a higher level of improvement and was classed as stage construction. On the remaining 52 miles the work completed was classed as reconstruction.

The total cost of the projects completed during the fiscal year 1933 was $234,383,376, of which $104,673,506 was paid outright as aid by the Federal Government and $4,502,467 was advanced from the emergency appropriation of $120,000,000 made by the Emergency Relief and Construction Act of July 21, 1932. Many of the projects completed during the fiscal year were begun in previous years; the above expenditures were not confined to the single year but were made throughout the period of construction.

Actual disbursements of Federal funds during the year, including all sums paid for work in progress, amounted to $101,266,331 of regular Federal-aid funds, and $62,131,961 of emergency construction funds.

The mileage completed during the year brings the total classed as completed to 107,869 miles, which excludes 3,986 miles in course of stage construction or reconstruction at the end of the fiscal year.

The total completed mileage includes more than 543 miles of bridges more than 20 feet in span and their immediate approaches, 47,329 miles surfaced with high-type pavements, 8,800 miles with intermediate-type surfaces, 39,420 miles with low-type surfaces, and 11,777 miles unsurfaced but graded and drained to satisfactory standard.

At the close of the fiscal year work was in progress on 12,383 miles of the Federal-aid system. This included, in addition to the 3,986 miles of stage construction above mentioned, 8,397 miles on which no previous Federal-aid work had been done.

Emergency Funds

The Emergency Relief and Construction Act of 1932, approved July 21, 1932, appropriated $120,000,000 to be advanced to the States for use in lieu of State funds to match the regular Federal-aid funds available. The sums advanced are to be reimbursed to the Federal Government by deduction from future Federal-aid appropriations over a period of 10 years commencing with the fiscal year 1938.

It was originally provided that only such parts of the sums apportioned as were actually expended for work performed before July 1, 1933, should be available. By subsequent amendment of the act the period of availability was extended to December 30, 1933.

On June 30, 1933, the original terminal date, all but $3,258,018 of the $120,000,000 appropriated had been obligated to definite construction projects and $85,254,000 had been earned by the completion of work. Of this amount $62,131,961 had been actually paid to the States.

The effect of this expenditure upon the volume of employment afforded by road work appears in the differences between employment figures for the fiscal years 1932 and 1933. In the former year only regular Federal funds were available for expenditure during the 10 months from September 1931 to June 1932, inclusive. During the first 2 months of the year the emergency appropriation of December 1930 was still being spent. Last year these conditions were reversed. Only regular Federal-aid funds were expended in July and August, and the expenditure of the $120,000,000 emergency appropriation began in September and continued throughout the year.

During the 10-month period of the fiscal year 1932, when only regular Federal-aid funds were available, the total direct employment afforded by Federal-aid road work was 524,170 man-months. During the similar period of the fiscal year 1933, work provided by the $120,000,000 emergency appropriation swelled the total of employment afforded to 1,085,144 man-months, or more than double the previous year's total.

On all Federal and State road work, including Federal work in the national forests and parks and public lands and independent State construction and maintenance work, direct employment totaled 2,666,058 man-months in the 10 months of the fiscal year 1932. The same classes of work in the 1933 period produced direct employment in the amount of 3,200,320 man-months, a gain in the latter year of 534,262 man-months. This gain was attributable entirely to the expanded Federal contribution.

Expenditure of the emergency funds beginning in September 1932 caused a sharp rise in employment on Federal-aid work from an average of 84,675 men in August to an average of 117,975 in September. Continuing at 117,024 in October the number employed rose to a peak of 123,389 in November and then dropped to a low of 72,592 in January 1933, after which it again rose quickly month by month to a midseason peak of 142,957 in June 1933. At midwinter the Federal-aid work of the last fiscal year gave employment to nearly 50,000 more men than were employed during the preceding winter. At midsummer the past year's employment exceeded that of the previous year by more than 70,000 men.

National Forest Roads and Trails

Construction of 359 miles of forest highways was completed during the fiscal year 1933. At the close of the year there were 5,593 miles of improved roads in the forest highway system.

Forest highways are the main roads traversing the forest areas and connecting with the Federal-aid highway system at the reservation boundaries.

WEATHER BUREAU

It was necessary to maintain the regular activities of the Weather Bureau at an expenditure from 20 to 25 percent less than that of recent years.

Various services had to be curtailed. Means were adopted, however, which increased the effectiveness of reports received from ships at sea, especially during the prevalence of hurricane conditions in the waters of the Caribbean Sea and the Gulf of Mexico. This was done with the cooperation of the major radio companies, whose stations along the South Atlantic coast make special calls for reports at designated hours from ships known to be in the areas in which a tropical disturbance is in progress.

The so-called "International Polar Year" extended from August 1, 1932, to August 31, 1933. By elaborate and concerted agreements between all meteorological services of the different nations, including intimately related scientific organizations, the year was marked by a unique set of complete and intensive observations of meteorological and related natural phenomena, especially at stations in high polar latitudes in the Northern Hemisphere. This work commemorated a somewhat similar project inaugurated in 1883. Analysis and development of the results obtained by this unique system of international observations will be extremely valuable.

HENRY A. WALLACE,
Secretary of Agriculture.

FINANCIAL STATEMENT

Appropriations, Department of Agriculture, Fiscal Years 1932, 1933, and 1934

During the latter part of the fiscal year 1933 it became necessary, as a part of the general economy program of the Government, to take further steps to materially reduce the expenditures for the regular continuing activities of the Department of Agriculture. The total amount appropriated by Congress for the work of the Department under its general budget for the year ending June 30, 1934, exclusive of payments to States for experiment stations, extension work, and cooperative forestry activities, was $55,081,923. The limitation which has been established on cash withdrawals from the Treasury decreases the available total of the Department for these purposes in 1934 to $43,685,402. This is a reduction of 38 percent below 1932 appropriations for comparable items, excluding the forest-fire deficiency item, for which 1934 appropriations have not yet been provided. A comparison of the cash-withdrawal limitations for 1934 with the amounts appropriated for 1932, 1933, and 1934 is shown in table 1.

TABLE 1.—*Appropriations of Department of Agriculture for general purposes, fiscal years 1932, 1933, and 1934*

[Exclusive of road funds, public works, emergency conservation, agricultural adjustment, and contributed funds]

Bureau and item	Appropriation, 1932	Appropriation, 1933	Appropriation, 1934	Cash-withdrawal limitation, 1934
DEPARTMENT GENERAL BUDGET				
(1) Ordinary activities:				
Office of the Secretary	$1,322,115	$1,206,547	$1,164,561	$1,029,442
Office of Information	1,420,961	1,335,800	1,226,287	916,966
Library	110,620	106,100	100,223	88,901
Office of Experiment Stations	399,410	294,294	226,961	198,670
Extension Service	1,793,560	1,688,170	1,583,822	1,189,267
Weather Bureau	4,497,720	4,164,038	3,731,235	2,909,884
Bureau of Animal Industry	16,085,195	15,324,947	14,398,524	11,709,444
Bureau of Dairy Industry	796,990	717,448	655,130	545,000
Bureau of Plant Industry	5,839,238	4,930,874	4,496,155	3,607,833
Forest Service	15,184,620	10,780,924	9,952,610	7,651,559
Bureau of Chemistry and Soils	2,104,051	1,925,080	1,766,458	1,470,305
Bureau of Entomology	2,863,740	2,471,700	2,213,968	1,729,241
Bureau of Biological Survey	2,229,170	1,756,177	1,356,280	1,017,261
Bureau of Agricultural Engineering	656,990	618,690	508,206	423,971
Bureau of Agricultural Economics	7,272,163	6,686,799	6,130,260	4,797,691
Bureau of Home Economics	246,700	233,365	212,749	169,338
Bureau of Plant Quarantine	3,747,930	2,490,125	2,158,514	1,611,015
Grain Futures Administration	221,480	218,838	200,000	173,139
Food and Drug Administration	1,810,228	1,716,167	1,589,505	1,493,000
Total, ordinary activities, exclusive of forest-fire deficiency	[1] 68,602,881	58,666,083	53,671,448	42,731,927
Forest-fire deficiency	4,260,000	1,000,000	(2)	(2)
Total, ordinary activities, as above	[1] 72,862,881	59,666,083	[3] 53,671,448	[3] 42,731,927

[1] Exclusive of $179,940 for general-expense appropriations of Bureau of Public Roads, fiscal year 1932, for which there are no comparable items in 1933 and 1934.
[2] Not yet appropriated.
[3] Not including item for forest-fire deficiency.

TABLE 1.—*Appropriations of Department of Agriculture for general purposes, fiscal years 1932, 1933, and 1934*—Continued

[Exclusive of road funds, public works, emergency conservation, agricultural adjustment, and contributed funds]

Bureau and item	Appropriation, 1932	Appropriation, 1933	Appropriation, 1934	Cash-withdrawal limitation, 1934
DEPARTMENT GENERAL BUDGET—continued				
(2) Forestry receipts and special funds	$2,315,500	$1,855,475	$1,410,475	$953,475
Total, Department general budget, exclusive of payments to States	[1] 75,178,381	61,521,558	55,081,923	43,685,402
(3) Payments to States (exclusive of national-forest receipt funds):				
Agricultural experiment stations	4,357,000	4,374,000	4,381,000	4,381,000
Extension work	8,672,936	8,728,096	8,738,096	8,738,096
Cooperative forest-fire prevention	1,775,000	1,611,580	1,587,513	1,190,635
Cooperative distribution of forest planting stock	95,000	79,960	74,730	56,047
Total, payments to States, as above	14,899,936	14,793,636	14,781,339	14,365,778
Grand total, Department general budget	[1] 90,078,317	76,315,194	69,863,262	58,051,180

[1] Exclusive of $179,940 for general-expense appropriations of Bureau of Public Roads, fiscal year 1932, for which there are no comparable items in 1933 and 1934.

Emergency and Relief Funds, 1934

Appropriation and expenditure information is now being classified under two main groups—(1) general funds, covering the ordinary or regular budget of the Federal Government, and (2) emergency funds, comprising moneys provided for agricultural, industrial, and other relief objects.

Emergency funds available for expenditure by the Department during the fiscal year 1934 include a direct appropriation of $100,000,000 for the administration of the Agricultural Adjustment Act, together with the receipts derived from taxes imposed under this act on processors of agricultural commodities; and approximately $483,000,000 allotted to the Department of Agriculture up to November 1, 1933, from appropriations authorized by sections 202, 204, and 205 of the National Industrial Recovery Act of June 16, 1933, including $400,000,000 for Federal-aid highways, $15,000,000 for national-forest highways, $5,000,000 for roads through public lands other than forest reserves, $7,000,000 for special road grants to certain States, $10,000,000 for emergency construction on national forests (including roads, trails, bridges, and other improvements), $26,000,000 for a large number of construction, repair, and improvement projects at the Department's field stations, as well as in the District of Columbia, and for the control of certain plant diseases and insect pests, and $20,000,000 for the purchase of forest lands as authorized by the Emergency Conservation Act of March 31, 1933.

The statement of expenditures and obligations for the last completed fiscal year (1933), which appears regularly in this annual report, follows:

Expenditures and Obligations, Department of Agriculture, Fiscal Year 1933

Expenses incurred under appropriations administered by the Department of Agriculture during the fiscal year ended June 30, 1933, totaled $252,861,396. Of this amount, $70,134,656 was for the general work of the Department and $182,726,740 for emergency activities, including road construction. These figures are summarized in table 2 and include (1) for all items other than road construction, the amounts expended and obligated for work done during the fiscal year 1933, and (2) for road construction, the amounts actually expended in 1933 for obligations incurred during that year and prior years. In addition to the total shown in this statement for road work, unpaid obligations were incurred in 1933 under emergency highway funds aggregating $454,832,059.

TABLE 2.—*Summary of expenditures and obligations, fiscal year 1933*

Group	Amount	Percentage of total for—	
		General items	All items
General:			
(1) Ordinary activities	$52,532,886	74.9	20.8
(2) Payments to States for support of agricultural experiment stations, extension work, and cooperative forestry activities, including fire prevention	14,613,646	20.8	5.7
(3) Forestry receipts, contributed, and other special funds (including $589,478 paid to States from national-forest receipts)	2,988,124	4.3	1.2
Total, general (items 1–3, above)	70,134,656	100.0	27.7
Emergency (including road funds):			
(4) Road construction (including $163,838,879 paid to States for Federal-aid highways)	[1] 177,977,564		70.4
(5) Emergency construction on national forests	4,193,292		1.7
(6) Emergency relief loans, including collections	539,203		.2
(7) Agricultural Adjustment Administration	16,681		
Total, emergency (items 4–7, above)	182,726,740		72.3
Total, Department of Agriculture, all purposes (items 1–7, above)	252,861,396		100.0
(8) Adjustment between total expended and obligated, as above, and checks actually paid by Treasury Department in 1933	−1,880,257		
(9) Total cash withdrawals from Treasury, 1933, on account of Department of Agriculture	[2] 250,981,139		

[1] Exclusive of $454,832,059 in unpaid obligations incurred during fiscal year 1933.
[2] As shown in the statement of classified receipts and expenditures of the Government for the period from July 1, 1932, to June 30, 1933, issued by the Treasury Department on July 15, 1933.

The total of $252,861,396, expended by the Department during the fiscal year 1933, was distributed by organization units and by types of activity as indicated in tables 3 and 4.

TABLE 3.—*Expenditures and obligations, fiscal year 1933, classified by organization units*

Organization unit	Ordinary activities	Payments to States [1]	Forestry receipts and special funds	Total
General:				
Office of the Secretary	[2] $1,001,945			$1,001,945
Office of Information	[3] 1,013,681			1,013,681
Library	98,351			98,351
Office of Experiment Stations	218,612	$4,359,000		4,577,612
Extension Service	[4] 1,509,335	8,652,815		10,162,150
Weather Bureau	3,524,589			3,524,589
Bureau of Animal Industry	[5] 12,676,564			12,676,564
Bureau of Dairy Industry	602,288			602,288
Bureau of Plant Industry	4,461,379			4,461,379
Forest Service (see also emergency items, below)	[6] 10,942,003	[7] 1,601,831	[8] $2,988,124	15,531,958
Bureau of Chemistry and Soils	1,643,331			1,643,331
Bureau of Entomology	2,109,500			2,109,500
Bureau of Biological Survey	[9] 1,673,800			1,673,800
Bureau of Public Roads (see also emergency items, below)	[10] 564,760			564,760
Bureau of Agricultural Engineering	551,565			551,565
Bureau of Agricultural Economics	5,844,167			5,844,167
Bureau of Home Economics	189,498			189,498
Bureau of Plant Quarantine	2,205,033			2,205,033
Grain Futures Administration	167,510			167,510
Food and Drug Administration	1,534,975			1,534,975
Total, general items, as above	52,532,886	[8] 14,613,646	2,988,124	70,134,656
Emergency (including road funds):				
Road construction		([11])		[12] 177,977,564
Emergency construction on national forests (Forest Service)				4,193,292
Farmers' Seed Loan Office				[13] 539,203
Agricultural Adjustment Administration				16,681
Total, emergency items, as above				182,726,740
Grand total, Department of Agriculture				252,861,396

[1] Exclusive of Federal-aid road funds and national-forest receipt funds. (See statement Payments to States, forestry receipts and special funds, and road construction, p. 105.)

[2] Expenditures listed under Office of the Secretary include the offices of Secretary and Assistant Secretary and general supervisory officials such as the Directors of Scientific and Extension Work and the Director of Personnel and Business Administration; including the following organization units which serve the Department as a whole: Divisions of Appointments, Budget and Finance, Accounts and Disbursements, and Purchase, Sales, and Traffic; inspection, personnel classification, mails and files, telephone and telegraph, post office, building guarding, cleaning, and maintenance, elevator operation, mechanical shops, power plant, motor transport, rent in the District of Columbia, and the cost of the Office of the Solicitor, which handles the legal work of the Department.

[3] Includes $660,834 for the job printing, publication, and binding requirements of the entire Department.

[4] Includes $883,416 contributed from Department funds toward salaries of extension agents in the field, supplementing direct Federal-aid payments to States under the Smith-Lever, Capper-Ketcham, and other extension acts.

[5] Of this amount, $4,594,090 was expended for tuberculosis eradication, including indemnities paid to livestock owners on account of animals destroyed, and $4,755,957 was for meat inspection.

[6] Includes $177,835 for acquisition of forest lands and $233,566 for construction of Forest Products Laboratory building.

[7] Payments to States for cooperative forest-fire prevention and distribution of forest planting stock. In addition, $589,478 paid to States from national-forest receipts is included under column Forestry receipts and special funds.

[8] See statement, Payments to States, forestry receipts and special funds, etc., p. 105.

[9] Includes $300,082 for purchase of land.

[10] For construction of building at Alameda, Calif.

[11] $163,838,879 paid to States for Federal-aid highways included under total for Road construction.

[12] Includes $6,645,711 for forest roads and trails under Forest Service; and $3,111,778 for national-forest highways and $168,220,075 for Federal-aid and other highways under Bureau of Public Roads. (See statement, Payments to States, forestry receipts and special funds, etc., p. 105.)

[13] Includes $400,503 for collection of loans. (All crop-production and seed loan work of Department was taken over by Farm Credit Administration May 27, 1933.)

TABLE 4.—*Expenditures and obligations, fiscal year 1933, classified by types of activity*

Type of activity	Ordinary activities		Payments to States [1]	Forestry receipts and special funds	Total	
	Amount	Percent			Amount	Percent
General:						
Research	$14,435,697	[2] 27.5	[3] $4,359,000	[4] $3,316	$18,798,013	7.4
Extension	2,139,182	4.1	[5] 8,652,815		10,791,997	4.3
Eradication or control of crop and animal pests	9,065,157	17.3			9,065,157	3.6
Regulatory work	10,524,741	20.0			10,524,741	4.2
Public-service activities	16,368,109	31.1	[6] 1,601,831	[7] 2,984,808	20,954,748	8.2
Total, general	52,532,886	100.0	[7] 14,613,646	[7] 2,988,124	70,134,656	27.7
Percentage of general total	74.9		20.8	4.3	100.0	
Percentage of grand total	20.8		5.7	1.2	27.7	
Emergency (including road funds):						
Road construction			([8])		[7] 177,977,564	70.4
Emergency construction on national forests					4,193,292	1.7
Emergency relief loans and collections					539,203	.2
Agricultural Adjustment Administration					16,681	
Total, emergency					182,726,740	72.3
Grand total, Department of Agriculture					252,861,396	100.0

[1] Exclusive of Federal-aid road and national-forest receipt funds. (See statement, payments to States, forestry receipts and special funds, and road construction, p. 105.)
[2] 20.6 percent of total for general items, and 5.7 percent of grand total.
[3] Payments to State agricultural experiment stations and to Hawaii and Alaska under Hatch, Adams, and Purnell Acts.
[4] Investigations under Cooperative work fund of Forest Service.
[5] Payments to State agricultural colleges and to Hawaii and Alaska under Smith-Lever, Capper-Ketcham, and supplemental acts.
[6] Payments to States for cooperative forest-fire prevention and for distribution of forest planting stock. In addition, $589,478 paid to States from national-forest receipts is included under column Forestry receipts and special funds.
[7] See statement, Payments to States, forestry receipts and special funds, and road construction, p. 105.
[8] $163,838,879 paid to States for Federal-aid highway included under total for Road construction.

Payments to States, Forestry Receipts and Special Funds, and Road Construction

(Analysis of figures shown under above heads in tables 3 and 4)

PAYMENTS TO STATES

Office of Experiment Stations:	
Payments to State agricultural experiment stations and to Hawaii and Alaska stations for research under Hatch, Adams, and Purnell Acts	$4,359,000
Extension Service:	
Payments to State agricultural colleges and to Hawaii and Alaska for extension work under Smith-Lever, Capper-Ketcham, and supplemental acts	8,652,815
Forest Service:	
Payments to States under Clarke-McNary Act:	
Cooperative protection of State and private timberlands against fire (exclusive of $50,859 for forest taxation and timber insurance research, included under ordinary activities in tables 3 and 4)	1,525,012
Cooperative distribution of forest planting stock	76,819
Total, above items	14,613,646

Additional payments to States (included under forestry receipts and special funds and road construction):		
From national-forest receipts, for the benefit of county roads and schools		$589,478
For Federal-aid highways		163,838,879
Total, payments to States		179,042,003

FORESTRY RECEIPTS AND SPECIAL FUNDS

National-forest receipt funds:		
Payments to States and Territories for benefit of county roads and schools	[1] $568,257	
Payments to schools funds, Arizona and New Mexico	[1] 21,221	
Construction of roads and trails for States	215,331	
Total, national-forest receipt funds (service)		804,809
Other special funds:		
Refunds to depositors (service)	69,340	
National Forest Reservation Commission, expenses (service)	576	
Cooperative work, paid from private contributions (including $3,316 for research and $2,110,083 for service activities)	2,113,399	
Total, other special funds		2,183,315
Total, forestry receipts and special funds		2,988,124

ROAD CONSTRUCTION

The following figures represent actual expenditures for road work made during the fiscal year 1933 under obligations incurred in that year and in prior years. These figures are exclusive of $454,832,059 in unpaid obligations incurred during the fiscal year 1933 principally under allotments of highway funds provided by the National Industrial Recovery Act and other emergency acts, including $451,868,039 for Federal-aid highways, $1,882,973 for national-forest highways, and $1,047,933 for roads through public lands other than forest reserves.

(1) Forest roads and trails:			
Regular Federal Highway Act funds (Forest Service)		$6,645,711	
Emergency funds for national-forest highways (Bureau of Public Roads)		3,111,778	
Total, forest roads and trails			$9,757,489
(2) Federal-aid highways (Bureau of Public Roads):			
(*a*) Under regular Federal Highway Act funds:			
Administrative expenses	$1,914,444		
Highway research and service activities	427,092		
Payments to States	[2] 101,266,331		
		103,607,867	
(*b*) Payments to States under special appropriations for restoration of flood-damaged roads and bridges:			
Alabama	17		
Florida	1,244		
Georgia and South Carolina	52,369		
Missouri, Mississippi, Louisiana, and Arkansas	119,428		

[1] Total paid to States from forestry receipt funds, $589,478.
[2] Total paid to States for Federal-aid highways, $163,838,879.

(2) Federal-aid highways (Bureau of Public Roads)—Continued.			
(*b*) Payments to States under special appropriations for restoration of flood-damaged roads and bridges—Continued.			
Vermont, New Hampshire, and Kentucky	$267,529		
		[2] $440,587	
(*c*) Under emergency funds:			
Payments (advances) to States	[2] 62,131,961		
Cooperation with States and Interior Department in construction of public-land highways	1,762,418		
		63,894,379	
Total, Federal-aid highways			$167,942,833
(3) Mount Vernon Memorial Highway (Bureau of Public Roads)			277,242
Total, road construction			177,977,564

Income From Department's Activities

Incident to the Department's work during the fiscal year 1933, receipts totaling $8,655,839 were paid into the Treasury, and fines were imposed and judgments recovered by the courts amounting to $65,450 in connection with the enforcement of regulatory laws, as follows:

Receipts:			
(1) Deposited to credit of miscellaneous receipts fund:			
National-forest receipts:			
Timber sales		$782,808	
Grazing fees		1,498,209	
Other business on the national forests		345,032	
		2,626,049	
Contributions from private cooperators, appropriated as a special fund (Cooperative Work, Forest Service) for various activities on the national forests and privately owned timberlands		2,344,402	
From other sources		1,013,320	
			$5,983,771
(2) Deposited to credit of applicable funds of department:			
Fees for classifying cotton, deposited to credit of revolving fund for conducting that work		68,894	
Seed and other loan collections		2,154,470	
Reimbursement to various Department appropriations for expenditures made therefrom		448,704	
			2,672,068
Total receipts			8,655,839
Fines: Fines imposed and judgments recovered by the courts in connection with violations of statutes intrusted to Department for enforcement			65,450
Total income from activities of Department of Agriculture			8,721,289

[2] Total paid to States for Federal-aid highways, $163,838,879.

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REPORT OF THE CHIEF OF THE BUREAU OF AGRICULTURAL ECONOMICS, 1933

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF AGRICULTURAL ECONOMICS,
Washington, D.C., October 5, 1933.

SIR: I transmit herewith a report of the work of the Bureau of Agricultural Economics for the fiscal year ended June 30, 1933.

Respectfully,

NILS A. OLSEN,
Chief of Bureau.

Hon. HENRY A. WALLACE,
Secretary of Agriculture.

The Bureau of Agricultural Economics has made every effort during the last year to put into effect the rule of rigid economy and at the same time to carry on its essential services. The basic character of this Bureau's work as a fact-finding, service, and regulatory agency of the Government has been demonstrated anew by the advent of the agricultural adjustment program. It is more and more manifest that planning in agriculture, whether it be by the individual farmer or by the Nation, requires a broad groundwork of accurate information concerning the country's crop and livestock production, prices, markets, and the economic and social relationships involved. The Bureau, in addition to maintaining its established program of research and service work, has cooperated with the Agricultural Adjustment Administration to the fullest extent, in supplying both basic information and the services of its staff.

COLLECTING AND DISSEMINATING CURRENT ECONOMIC INFORMATION

CROP AND LIVESTOCK ESTIMATES

During the spring of 1933 it became necessary for the Agricultural Adjustment Administration to have county estimates of acreage, yield, and production of wheat, corn, cotton, rice, and tobacco. Such information was essential in planning its campaigns on cotton and wheat, in examining the cotton offers, and in setting the official allotments for wheat. Detailed data of such magnitude had not hitherto been available. The entire staff of the Division of Crop and Livestock Estimates in Washington and in its 40 field offices was employed over a period of several weeks in preparing these estimates. The Bureau's regularly collected data on prices at the farm were used as a basis for determining the official parity price and in determining the processing taxes.

In addition to its regular scheduled crop and livestock reports, the crop estimating unit carried out several pieces of work involving noteworthy statistical undertakings and making available important results. Estimates of milk production on farms by States for the period 1929–32 were completed and published during the year. Similar data on chicken and egg production were practically completed and have been published since the close of the fiscal year.

Beginning in April 1933 the Division of Crop and Livestock Estimates began the publication of quarterly estimates of stocks of grain. More detailed information respecting supplies of certain basic commodities has become essential as the "surplus problem" has become one of national concern.

The administration of the Agricultural Adjustment Act also led to demands for more information relative to fruit production and utilization, and at the close

of the fiscal year one special survey—that of the clingstone-peach production in California—was under way. At the same time plans for additional investigation into the production of other fruits, particularly citrus, were being made in anticipation of the need for similarly detailed information on other specialty crops.

POTATOES MOVED BY TRUCK

The regular reports on potatoes and sweetpotatoes were maintained during the year, but a number of special potato reports were discontinued for lack of funds. One interesting feature of the January analysis of the disposal of the potato crop this year indicated, in rough measure, the striking growth of the use of motor trucks in moving potatoes to market. The indications were that at least 40 percent of the marketings of intermediate and late-crop potatoes up to January 1 had moved to market by motor truck.

CROP ESTIMATES HELPED GROWERS AND CANNERS OF VEGETABLE CROPS

An example of the way in which hard times stimulate the demand for crop reports is found in the vegetable-canning industry. Because of disastrously low prices, many canners went into the hands of receivers and others temporarily closed their plants rather than operate at a loss. Large numbers of canners, facing the problem of survival, made heavy demands on the staff of the Bureau to obtain reliable information on acreage and probable production, and an analysis of these data that would assist them in conducting their individual operations and in formulating plans for group action. Special effort was made to obtain data for use in cross checking the information on yields per acre, as well as data on condition of various crops. In spite of the fact that two of the major vegetable-canning crops—sweet corn and green peas—were affected by adverse weather and growing conditions in 1932, the early forecasts of production of canning crops issued during the summer came within a few percent of foretelling the actual sizes of the packs, before the crops were harvested and from 6 weeks to 6 months before the actual pack statistics became available through other official sources.

It is the constant effort of the Bureau to present the current situation in regard to production in all lines of livestock, as well as crops. Concerning the technical method of estimating the pig crop, the knowledge gained from annual surveys of the pig crop for 10 years made it possible this last year to prepare definite estimates, fall and spring, including the number of sows farrowed and pigs saved. Although data on actual marketing are not yet complete, it is apparent that the estimates for the 1932 pig crop represent an important new step in statistical accuracy in this field.

In respect to poultry production, revised estimates were completed and published during the year covering the numbers and value of chickens on farms January 1; chickens raised, eaten on farms, and sold; hens and poultry on farms January 1; and eggs produced, eaten on farms, and sold to date; these estimates covering the entire period 1925–32. This gives the poultry industry a background of fact that has been unavailable hitherto. The current reports issued, showing numbers of hens, pullets, and young chickens in farm flocks and the number of eggs laid on the first day of the month, now give reliable information on production.

Some features of the Crop Reporting Service have been eliminated because of reduced funds. Among these are the special fruit production and utilization surveys, the annual inquiries regarding the quality of the fruit crop, potatoes, and sweetpotatoes, the report on March 1 farm stocks of potatoes, estimates of the cucumber crop grown for pickling, planting-intention reports on most of the commercial truck crops grown for shipment, and various current season reports on minor vegetables, fruits, and canning crops. In addition, it was found necessary not only to curtail the content of the reports issued but also to limit closely the number of copies for direct distribution. The monthly reports on fruit and potato prospects containing pertinent comments from the various States to amplify the regular statistical information were discontinued in the interest of economy.

WEEKLY ESTIMATES OF COTTON GRADE AND STAPLE

In response to rather insistent demands from the producers and the trade for more timely information on the quality of cotton during the ginning period, a series of weekly reports was inaugurated. These reports, summarizing the various grades and staples week by week for each of the cotton-producing States and their major subdivisions, were released for the first time this season.

Data on the quality of cotton ginned at individual gins that furnished samples for classification, showing the number of bales of each grade and staple ginned during the season, have been furnished the ginners for the last 5 years. In addition, in response to their requests for more detailed information, copies of the classification sheets, without numbers identifying individual bales, were supplied each ginner during the 1932–33 season as soon as his samples were classed.

This service met with a hearty reception and has occasioned much favorable publicity in the country press. Ginners and cotton growers freely expressed the opinion that this service was very valuable this season, for it not only acquainted producers with the quality of cotton grown in the various localities, but it was a direct aid to them in properly marketing their crop. It is believed that this type of direct, prompt service will have a decided effect in that it will enable growers to decide on the kind of cotton that will return to them individually the largest net profit.

CROP AND LIVESTOCK INFORMATION FROM FOREIGN COUNTRIES

It has been the objective of the Bureau to build up gradually a clearing house of information which should keep the American farmer and public apprised currently of agricultural production and trade over all the world. This information service has been fairly well perfected within the United States and is likewise within range of accomplishment in regard to the principal competing countries. Progress in this field, however, has been somewhat retarded by lack of funds to develop the Foreign Agricultural Service of the Bureau, authorized by the act of June 5, 1930.

During the last year the procuring of information on production in foreign countries and competitive supplies has involved personal investigations of crop conditions and yields of wheat, corn, cotton, and other staple crops; and for some countries, in the absence of Government forecasts, Bureau representatives have made tentative forecasts of these crops in order to supply American interests with advance information. Independent estimates of fruit and nut crops have constituted practically the only information available to American interests on these crops in many competing areas.

For the leading crops that compete with American products, an analysis has been made in each case of crop information respecting size of crop, grade or quality, domestic utilization, exportable surpluses, or import requirements. Similar information is procured and corresponding analyses have been made on wool, pork, lard, and butter. On the demand side, the Foreign Agricultural Service has gathered and disseminated information on economic conditions and purchasing power in foreign markets, trade barriers, and other factors affecting world consumption of American farm products. This last year one could scarcely pick up a trade paper or listen to a radio market report in this country without learning facts on the foreign agricultural situation gathered originally by the Bureau's staff.

England represents the leading export market for American apples and fresh fruit, and the reports by the fruit specialist stationed in London on the prevailing prices for different varieties, current and prospective arrivals, and condition of the market, have proved especially useful to apple, citrus, and other fruit exporters. The Bureau's fruit specialist at London has been able to advise many individual growers and shippers in the United States as to the condition of their packs and the reputation of their brands, and to make suggestions designed to increase the volume of American fruit exports to the English and European markets and the price. During the year the imposition of sanitary restrictions in France and governmental regulations in other markets created new market problems for American shippers and led to intergovernmental negotiations, in which the Bureau's fruit specialist in his capacity as a representative of the American Government was able to be of substantial assistance.

The livestock and meat specialist in London has furnished monthly reports on the wool and pork markets of England. The reports on pork have had particular significance in view of changing price and supply conditions in the English bacon and ham markets, brought about by the quota restrictions. During June 1933, for the special use of the Agricultural Adjustment Administration, a study was made, by London and Berlin representatives, of the Netherlands plan to control hog production and raise prices to producers.

Prices of hogs advanced substantially under the Netherlands plan partly because of a liquidation of heavy supplies and partly because of price-fixing policies. Unprofitable hog prices had so curtailed breeding operations that production-control measures had not been subjected to a real test.

Reports from the Berlin staff continue to be the leading source of our information on foreign competition and demand in northern, central, and western Europe for American wheat, cotton, lard, and fruit. Development of the German and French wheat industries to an export basis, a substantial recovery in the continental textile industry, and, in spite of severe competition, gains in consumption of American fruit on the Continent, were some of the features of reports during last year from the Berlin office. The Berlin office is likewise a source of some information on the wheat situation in Russia. Developments in Germany in respect to the situation in regard to animal fats have been given particular attention, in view of the adverse effects which the extremely high German import duties and monopoly control of fats are having on the exports of American lard.

USE OF AMERICAN TOBACCO IN EUROPE

A study has been made by a tobacco specialist in the Foreign Agricultural Service for each of the European countries of the quantity and quality of tobacco production and manufactured tobacco products and of consuming habits, and the influence of these factors on the demand for American tobacco. The report classifies the types of tobacco being grown at present in the European countries, estimates production, and indicates a tendency toward increased production in several countries. An examination of the tobacco products of each country discloses the extent of utilization of American leaf in these products. It is pointed out that changes are taking place in the kinds and sources of the leaf entering into these tobacco mixtures, and changes in this respect are curtailing the demand and consumption of American leaf. Slight changes are taking place in consumption habits and in consumer demands, but to a considerable extent changes in consumption of American leaf are being influenced by monopoly policies and discriminatory tariffs. Preferential tariff rates for colonial-grown tobacco and low purchasing power are other factors curtailing the use of American leaf.

WATCHING THE ORIENTAL MARKET

The restrictions in the European markets have given oriental outlets for American farm products added significance. Indications are that China and Japan are coming to be regarded as increasingly important markets for American wheat, cotton, and tobacco. In most of these lines, however, American farmers must meet severe competition from wheat from other exporting countries, from foreign cotton, and from flue-cured tobacco grown in China. In view of the almost complete lack of reliable current information in China, great dependence is placed upon the reports from our Shanghai office.

DEMAND FOR AMERICAN COTTON IN JAPAN

Japan has attained a position of leading importance as an importer of American cotton. In 1932–33 Japan imported more cotton from the United States than from any other country. As the consumption of American cotton is variable, a study has recently been completed by a cotton specialist of the Foreign Agricultural Service, of the factors determining the consumption of American cotton in the Japanese industry. The study reveals the significance to the consumption of American cotton of the increasing exports of fine piece goods from Japan requiring the use of medium- and high-count yarns and accordingly larger percentages of American cotton in the mixtures entering into these yarns. The use of American cotton is more or less indispensable in the medium- and high-count yarns, but in yarns of 20 count the price of American cotton in relation to the price of Indian cotton determines to a considerable degree the percentage of American cotton. In the low-count yarns, the use of Indian cotton predominates and except in years when the price of American cotton in relation to Indian cotton is extremely favorable, as in 1926–27 and 1931–32, it is difficult for American cotton to displace Indian cotton in these yarns. In years when American prices are low, however, American cotton displaces Indian cotton and the aggregate consumption of American cotton is greatly enlarged.

AGRICULTURAL OUTPOSTS IN THE SOUTHERN HEMISPHERE

In the Southern Hemisphere, the offices of the Foreign Agricultural Service in Argentina, Australia, and the Union of South Africa were called upon last year to provide detailed information respecting wheat, wool, flaxseed, dairy products, tobacco, fruit, and beef. The studies made by the staff in Buenos Aires have assumed special significance in view of the current interest in plans for reciprocal

trade agreements with Latin American countries. The situation respecting wheat production in Argentina and Australia has been fully reported to our market currently. The predominance of Australia in the world's wool trade has made the reports from the representative at Sydney of value to American producers. In South Africa, where fruit and tobacco production is gaining in importance, reliance is placed upon the studies of our representative to provide the fact background concerning the actual and potential replacement of American fruits and tobacco in the British markets by South African products. Deciduous-fruit exports from South Africa, which in 1932 were 40,000 shipping tons, will probably reach 80,000 tons within 5 years. Citrus-fruit exports, which in 1932 were 2,000,000 boxes, will probably reach 3,000,000 boxes in 5 years. The trend of tobacco production is upward.

COMMERCIAL POLICIES OF FOREIGN COUNTRIES AND TRADE BARRIERS

An important function of the Foreign Agricultural Service is to supply current information and to conduct research on the commercial and economic policies of foreign nations as they affect competing supplies and agricultural exports from the United States. During the last few years tariffs, quota restrictions, and other trade barriers in foreign countries affecting American agricultural exports have increased enormously both in number and in severity. These measures have greatly reduced the outlet for some of our products in important foreign markets and have been a contributing cause of the decline of farm prices generally in the United States.

WHAT TRADE BARRIERS HAVE DONE TO OUR EXPORTS

During the year a report entitled "World Trade Barriers in Relation to American Agriculture" was prepared in response to Senate Resolution No. 280, 72d Congress. This report, printed as Senate Document No. 70, 73d Congress, contains a description of the various types of measures affecting agriculture which are in operation in foreign countries at the present time and indicates the nature of the conditions which have given rise to them. It also contains an appraisal of the effects of these measures on several major agricultural commodities and groups of commodities.

It is significant that in the case of wheat, it is estimated that the direct effect of trade barriers alone in 1932 was to make wheat prices about 25 cents a bushel less than they would otherwise have been.

WHAT OUR COMPETITORS ARE DOING IN COTTON

Egypt begins to loom up in the cotton trade. Here is an example of long-range appraisal so important to our Cotton Belt. Egyptian cotton is second only to Indian cotton as a competitor with the American staple in world markets. A field study of the factors determining cotton production in Egypt was completed in June 1933 by a cotton specialist in the Foreign Agricultural Service.

The increase in acreage and higher yields resulting from shifts in varieties of cotton are the chief factors in appraising future Egyptian production. The expansion of the cotton area from the present 2,000,000 acres to 2,750,000 or 3,000,000 acres depends upon the completion of a land-reclamation program costing almost $100,000,000. It is estimated that this development will require 25 years.

There has been a downward trend during the last 20 years in the yields of Egyptian cotton, owing in part to an expansion of the acreage of long-staple but low-yielding varieties. This trend has recently changed, and the present tendency is toward shorter staple but higher yielding varieties of cotton.

If a part of the reclamation program is completed and the trend toward a higher yielding but shorter staple cotton continues, Egypt, in the next 5 to 20 years, may produce between 1,800,000 and 2,400,000 bales of cotton. Not only will an increase of cotton supplies have an influence on the world prices for American cotton but the shift in staple length will likewise be significant.

CURTAILMENT OF THE FOREIGN AGRICULTURAL SERVICE

All of the field offices and the personnel as constituted a year ago functioned during the year 1932–33. At the end of the fiscal year, however, economy measures necessitated closing the offices in Australia and the Union of South Africa and recalling the Bureau's representatives there. One man each was recalled from the offices in Buenos Aires, Belgrade, and Marseilles.

STANDARDIZATION AND GRADING OF FARM PRODUCTS

The events of the last year served to emphasize the value of the standardization and grading of farm products by a governmental agency. It cannot be too often reiterated that orderly, efficient distribution of farm products must rest upon a system of standardized grades which is universally recognized and respected by buyers and sellers. The Bureau's work in this field has now progressed so far that the results seem to justify the conclusion that this is a governmental function which should be broadened into a more complete and Nation-wide service. There can be little question that the standardization and grading of important agricultural products is a service which the Government can and should render, not only in the interests of producers but also of the whole public.

GRADING CANNED FRUITS AND VEGETABLES

The development of grades as a basis for the grading and certification of canned fruits and vegetables, authorized 2 years ago, has been pushed as vigorously as possible during the year. Grades have been promulgated by the Secretary of Agriculture for canned corn, both cream and whole-grain style, tomatoes, peas, and snap beans, and tentative grades have been formulated and are now being used for 22 additional canned fruit and vegetable products.

There is constantly increasing evidence of the interest of canners, distributors, and consumers in uniform quality grades for these products. The Bureau, when requested, inspects and certifies the quality of such canned goods on the basis of its grades, charging a small fee for the service. This is done for the information of canners or distributors in advance of labeling. Inspections may also be made of samples drawn from specific commercial lots in transit or in storage; in such cases the certificates are used to establish the quality of the merchandise in a particular transaction, and sales may be negotiated on the basis of the certificate rather than by the shipment and examination of actual samples. The method of sale by sample imposes a considerable burden on the industry as it often involves the shipment of many samples to many prospective buyers before a sale is made. During the year at least one large regional canners' association began to report the sales of its members in the terms "Grade A", "Grade B", or "Grade C." This is a significant development as it has heretofore been regarded as impracticable to establish a market-reporting system for canned fruits and vegetables, as has been done for numerous other farm products, because there was no recognized grade foundation on which to base sales reports.

One of the most significant developments during the year has been the rapidly growing interest on the part of consumers in the labeling of canned fruits and vegetables by grade. The consumer is now almost entirely dependent upon a general knowledge of the quality of certain advertised brands or upon the statements of the retailer. There is such a wide range of commercial value above the substandard line established under the McNary-Mapes amendment to the Food and Drugs Act that consumers should be provided with reliable information as to quality variations as a guide to their purchases of these products. There is such a multiplicity of brands, both advertised and unadvertised, that no consumer can hope to learn the merits of all the brands likely to be found in retail stores in any one town. Moreover, many labels carry not only meaningless but also misleading statements with respect to quality.

One of the interesting developments this year has been the disposition of some canners to label sizable quantities of their packs in the terms of the grades formulated by the Bureau, such as grade A or grade B. Interest on the part of public purchasing institutions in the advantage of uniform grades is also increasing. During the year the city of Boston and the Cook County Emergency Relief Committee of Chicago, one of the largest of its kind in the United States, incorporated the grades recommended by the Bureau in their specifications for the purchase of canned fruits and vegetables. Substantial quantities of these products also were graded by the Bureau for Federal purchasing institutions.

INSPECTION OF FRESH FRUITS AND VEGETABLES

The value of uniform grades and official inspection is well recognized in the fresh fruit and vegetable industry. During the year the Bureau inspected 43,985 carloads in the city markets, and 216,792 carloads at shipping points in cooperation with the States. This was a decrease of 74,871 cars from the previous year, the decrease being largely due to a decrease of about 181,000 carloads

moved to market by rail last year. There are now only three States with which the Bureau does not have cooperative agreements for inspection at shipping points.

An interesting development in the shipping-point inspection service in Puerto Rico, conducted in cooperation with a growers' organization, was the willingness of European receivers to make direct purchases of citrus fruits f.o.b. shipping point on the basis of Federal grade certification. In previous years most of the Puerto Rican fruit exported to Great Britain moved through New York, but last year direct shipments were made from San Juan to Liverpool. Growers were not slow to realize the benefits to be derived from standardization and official certification, and the percentage of fruits shipped under Federal grades increased rapidly.

An important development of unusual interest to exporters of apples and pears was the passage by Congress on June 10, 1933, of the so-called "Export Apple and Pear Act". In general terms this act makes it unlawful to export apples or pears unless they are accompanied by a certificate issued under authority of the Secretary of Agriculture showing that such fruit meets the Federal or State grade recognized by the Secretary as the minimum of quality for shipment in export. In effect, this legislation makes mandatory the cooperative arrangement previously in operation between the fruit interests and steamship lines under which export shipments of apples and pears would not be accepted for shipment by the steamship lines unless accompanied by the export form certificate issued by the Bureau.

RICE-INSPECTION SERVICE

Rice grading, especially in the States of Louisiana, Texas, and California, is becoming an important factor in the marketing of rough rice. It provides a basis for a definite market-news service and for the establishment of equitable premiums and discounts. The demand for rice grading under the supervision of the Bureau is steadily increasing, and a large number of rice producers, millers, and exporters believe that compulsory grading of rice would be of distinct advantage in the marketing of this crop.

Federal-State grade certificates covering 9,385 commercial lots of rice were issued during the year. These inspections represent an increase of 579 inspections over the inspections made during the previous fiscal year.

Not only do rice producers use this service to a large extent in marketing their rough rice but each year the rice exporters are using the grading service to a greater extent in connection with the export sales of milled, brown, and rough rice. Government agencies that loan money to rice farmers for production and marketing purposes are demanding Federal-State rice-grade certificates to an increasing extent. Also the grade certificates are being used to a greater extent each year in connection with the issuance of insurance policies covering rice and the settlement of insurance claims.

CERTIFYING OTHER PRODUCTS

Certification work based on Federal standards was continued throughout the year for dairy and poultry products, this work being extended in Washington, New Jersey, Pennsylvania, and Massachusetts under new cooperative agreements with these States. Shipping-point grading service at several points in Missouri and Kansas was resumed after a lapse of several months. Certification work was carried on in regard to hay, beans, soybeans, and rice, and in the verification of the origin of alfalfa and red-clover seed.

An important outcome of the use of Federal standards in the marketing of beans in Michigan was the interest shown by distributors in consuming territories in the use of branded bags showing the U.S. grade. This practice has been satisfactory to distributors and carries the benefits of Federal standards and inspection closer to the consumer.

The continued movement of soybeans for export, which began during the fall of 1931, resulted in an increased number of inspections. The total quantity inspected for export last year was 2,760,000 bushels, as compared with 1,850,000 bushels during the previous year. The satisfaction with which these soybeans were received at German and English mills indicates that the quality represented by the grade U.S. No. 2, on which they were sold, is satisfactory for the purpose and reflects an accuracy and consistency in the application of Federal standards to export shipments.

TWENTY THOUSAND RANCHERS COME TO SCHOOL

A striking and effective educational activity was the livestock-grading demonstrations conducted in cooperation with the Extension Service in various parts of the country. As has been the case for several years, one man devoted practically his entire time to such work, largely in the intermountain and far-western sheep- and cattle-producing areas. Another spent considerable time in similar work in the Middle West and in the eastern and southeastern lamb-producing areas. In the case of the specialist first mentioned, the demands for his services always far exceed the time available and his itinerary is usually made up from a year to 18 months in advance.

Some of these grading demonstrations were held at agricultural colleges, but most of them were held on individual ranches. In all instances, live animals were used. On the ranches cattle were rounded up on the range and brought in, in whatever numbers the grader required for his purpose. Many people drove from 50 to 100 miles to attend. Demonstrations have been held on some of the same ranches for 4 years. At all such gatherings the grader not only actually sorts the animals on the basis of the Bureau's standards, always giving reasons for his action, but he also gives his listeners pertinent information regarding central livestock-market practices and consumer preferences for meat. In other words, he emphasizes the economic basis for the standardized grading.

More than 20,000 persons attended these livestock grading meeetings. It was necessary during the year to decline 15 requests from States for these demonstrations because of the lack of personnel.

WOOL-GRADING SCHOOLS

Twenty-four wool-grading schools were held during the year in North Dakota, South Dakota, and Nebraska. They were held under the auspices of the Extension Service and colleges, with the wool growers' associations cooperating. Records indicate that these schools reached a large part of the agricultural population engaged in wool growing.

MEAT GRADING

The demand for officially graded and stamped meats has continued to expand in proportion as the consuming public has become acquainted with the grade names and their relation to quality. The total of all meats graded during the year was 231,098,192 pounds. The beef-grading branch of the service showed an increase of 29,695,069 pounds, or 16.2 percent, over the previous year. Approximately 18,000,000 pounds of beef alone were graded every month, but the beef-grading service is at present very limited in scope.

At present there are many standards for meats as set up by different packers, and a general lack of uniformity of such standards from season to season exists among packing concerns who do their own branding. Neither the producers nor the consumers of meat animals will receive maximum benefits from grading until a single set of uniform standards is in effect the country over.

TOBACCO GRADING

Two State legislatures enacted legislation during the year for the compulsory grading of tobacco. The first was Maryland. To meet the terms of this law, our Tobacco Section is now perfecting standards and grades for the Maryland types, and negotiations for a cooperative agreement with the Maryland authorities are under way. More recently the Virginia General Assembly in special session enacted into law a bill providing for the compulsory grading of tobacco produced in the Virginia fire-cured district. This is one of the four types of tobacco produced in the State, and the measure was sponsored by growers in the district affected.

The establishment of standard grades for the various types of tobacco is fundamental and must precede changes and improvements in tobacco-marketing methods, some of which are antiquated and grossly unfair to the grower.

GRADING MADE MONEY FOR GROWERS

An incident may be cited in the Virginia fire-cured district the past year in which an association of growers, without resorting to pooling operations, made intelligent use of the tobacco-grading service, to their financial advantage. Stop prices were placed on each grade so that no tobacco within the grade sold at less than a certain minimum price, determined by current market conditions. This,

in turn, brought about an average increase of 20 percent in the selling price per grade as compared with the average selling price for the same grade under open-market conditions. The most glaring weakness of the auction-marketing system is the lack of stability of prices according to grade.

During the year the tobacco-grading service was utilized by the Virginia Dark Fired Tobacco Growers' Association, the Stemming District Tobacco Growers' Association, the western and the eastern Dark Fired Tobacco Growers' Marketing Associations, and the Northern Wisconsin Tobacco Growers' Cooperative Association. The Stemming, eastern, and western associations are located in Kentucky and Tennessee. Grading service was supplied on independent floors in markets of Virginia, North Carolina, South Carolina, Kentucky, and Tennessee, and a similar service was supplied to the Florida Shade Tobacco Credit Corporation, which is an association of growers, dealers, and packers of shade-grown tobacco produced for cigar wrappers.

REGULATORY SERVICES

PERISHABLE AGRICULTURAL COMMODITIES ACT AND PRODUCE AGENCY ACT

The Perishable Agricultural Commodities Act of 1930 requires that any individual, partnership, corporation, or association carrying on the business of a commission merchant, dealer, or broker in the handling of fresh fruits or fresh vegetables in interstate or foreign commerce shall be licensed by the Secretary of Agriculture, and it makes certain practices in the handling of such products unlawful.

The Produce Agency Act is a criminal statute providing fine or imprisonment for the fraudulent or dishonest handling of produce by a commission agency. Violations of this act, therefore, are reported to the Department of Justice, and convictions are secured only after trial in Federal district courts. Convictions or pleas of guilty were obtained in Federal district courts in 12 cases during the year comprising 20 separate complaints. In 3 cases the court imposed sentences of 3 months' imprisonment, in 2 cases the minimum fine of $100 was imposed, and in other cases fines of $200 or $250 were imposed.

Work done in enforcing these two acts shows little change during the year in the number of complaints handled but does show considerable increase in the number of hearings held and the number of orders issued by the Secretary under the Perishable Agricultural Commodities Act and in the number of cases transmitted for prosecution under the Produce Agency Act. Under the Perishable Agricultural Commodities Act, at the close of the fiscal year, 14,347 licenses were in effect as compared with 15,327 in effect at the beginning of the fiscal year; 2,535 complaints of violations of the act were filed during the fiscal year as compared with 2,482 filed during the preceding year; 205 formal hearings were held, as compared with 172 held during the previous year; and 371 cases were disposed of by decisions of the Secretary as compared with 80 cases covered by decisions during the previous fiscal year.

Since the shortened procedure, after waiver of hearing, was provided to expedite disposing of complaints under the act, the instances in which the parties to complaints have availed themselves of this privilege have been increasing constantly. During last year, about 37 percent of the cases disposed of were decided under a shortened procedure which involves the submission of the facts by both parties to the Department of Agriculture for decision without a formal hearing in which oral testimony is taken. This procedure reduces the expense to all parties concerned and expedites action.

THE UNITED STATES COTTON FUTURES ACT

The administrative duties of the Bureau in the enforcement of the United States Cotton Futures Act are essentially of a service character. The principal duties at this time are: (1) The certification of the grade and staple of cotton delivered in settlement of futures contracts; (2) the supervision of difference quotations on grades above and below Middling in 10 spot cotton markets designated as bona fide spot markets, the averages of which are used in calculating the prices at which such grades as are tenderable may be invoiced when delivered; and (3) an information service on cotton price quotations. The act does not undertake to deal with such matters as the conduct of trading upon the exchanges, the truth of gossip or rumors circulated about the market, or the extent of allowable price fluctuations which in recent years have been the subject of public concern; nor does it provide authority to obtain information concerning these mat-

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ters. In recent years and particularly last year when speculative short selling of cotton was popularly believed to be contributing to the demoralization of prices, the lack of comprehensive information of this kind has proved a handicap not only to corrective action but also to the formulation of an intelligent policy with respect to speculation, and to the control of manipulative trading practices that might exist.

The various lines of work authorized by the Cotton Futures Act were continued by the projects already established, and there was a notable increase in the classification and certification of cotton for future contract delivery—224,987 bales as compared with only 42,148 in the preceding fiscal year.

THE UNITED STATES COTTON STANDARDS ACT

The more important features of the United States Cotton Standards Act, passed in 1923, are to establish the official cotton standards of the United States as the legal basis of spot cotton transactions in interstate and foreign commerce, to provide for the classification of any cotton or samples submitted for the purpose to officials of the Department, to extend existing authority for the standardization of cotton, and to authorize the licensing of cotton classifiers upon presentation of evidence of competency. The only mandatory provision of the statute is that which requires that the official standards shall be used in all transactions in interstate or foreign commerce in which any standards or systems of classification are used.

Shortly after the enactment of this legislation the way was cleared by a series of agreements with nine of the principal cotton trade organizations of Europe for use of the official grade standards in international trade. These agreements originally obligated the Department for 2 years. They have now been in effect for 10 years, the fifth biennial Universal Cotton Standards Conference having been held in Washington last year. These biennial conferences are for the purpose of approving copies of the universal standards for American cotton for use by the Department of Agriculture and by the European organizations during a 2-year period. At the 1933 conference 65 full sets of copies of the universal standards totaling 1,300 boxes and an additional 170 boxes were approved.

Copies of the universal standards, and of the other official cotton standards of the United States, continue in general use throughout the world wherever American cotton is sold. A total of 3,614 boxes of the standards for grade and color were distributed during the year as compared with 2,847 boxes in the previous year. Staple types distributed totaled 5,484 as compared with 6,829 during the preceding year. Numerous orders for copies of the standards were in process of handling at the close of the fiscal year.

Revised standards for Extra White cotton were promulgated during the year. The Extra White standards apply in the grade classification of upland cotton wherever grown, which includes all of the American commercial production except the American Egyptian and sea-island types. As repromulgated the Extra White standards conform with the White grades of the universal standards in leaf and preparation and simplify primarily the color differences. In preparing the new Extra White standards, bales were selected from each major section of the Cotton Belt, and as a substantial part of the crop in some seasons is of the Extra White color, it is expected that the new standards which became effective August 10, 1933, will contribute to the convenience and accuracy of classification of cotton by its color description.

The work of supervising cotton classifiers licensed under the act has continued to grow in importance. Of the 260 licenses issued during the year, 202 represented renewals and 58 were new licenses. The use of licensed cotton classifiers by several of the leading cotton cooperative associations continued. Reports from licensees indicated that during the last cotton season they determined the grade and staple of more than 3,700,000 bales. The more general recognition of the value of the service given by licensed classifiers under supervision of this Bureau and the widespread use of the service in a number of the cotton States have been helpful in carrying back to individual growers information that has enabled them to obtain premiums for better qualities corresponding to premiums applying in the larger markets. At the same time there is reason to believe that the service has been helpful in retarding or preventing the gradual lowering of the quality of production which in the past has resulted from inadequate knowledge among farmers as to the grade and staple of cotton produced by them.

Several of the Bureau's specialists in cotton classing were designated to assist the American Red Cross in connection with claims involving large quantities of cotton issued to that organization for the relief of distress pursuant to a joint

resolution of the Seventy-second Congress. Representatives of the Bureau had had reclassified for the American Red Cross approximately 80,000 bales by the close of the fiscal year.

The Cotton Standards Act was amended by a joint resolution of Congress approved March 4, 1933. In substance this amendment provides for the extension to cotton growers of additional facilities for the classification of cotton as authorized in the Cotton Standards Act, and authority, not heretofore available, is given the Secretary of Agriculture to license samplers. No additional funds have yet been made available for these purposes.

UNITED STATES WAREHOUSE ACT

The United States Warehouse Act is a semiregulatory activity. Its licensing provisions are not mandatory, but when a warehouseman elects to be licensed he is subject to all the requirements and penalties of the act. Separate regulations apply to each of the commodities eligible for storage under the act. During last year the following commodities were eligible: Cotton, grain, wool, tobacco, nuts, potatoes, sirup, dry beans, dried fruit, broomcorn, seeds, canned foods, cold-packed fruit, cottonseed, and cherries in sulphur dioxide brine.

The primary purpose of the Warehouse Act is to convert agricultural products into sound collateral in the form of warehouse receipts. With the closing of many banks in production areas and in financial centers, the difficulties in financing products that were waiting to be marketed were more acute last year than ever. In whole counties in many production areas no banks were open. Producers in those counties had either to sell their products as harvested or to turn to governmental financing agencies or to large city banks for credit. The same was true of many dealers and shippers of these products, not only in production areas but also in many trade centers. New financial and credit contacts had to be made. Many of these applicants for credit were strangers to these financing institutions. Naturally they had to present collateral that appealed to the lending agencies. The Federal warehouse receipt served as an acceptable medium. The Farm Credit Administration and the Reconstruction Finance Corporation have sought such receipts, and banks in every section, whether in agricultural production areas or in money centers, found in this receipt a form of collateral that enabled them to make an intelligent loan even though the commodity was at a distant point in a warehouse of which they had never heard before. Thus even in this trying year it was possible to obtain credit and in many instances at unheard-of low interest rates.

Difficulties in commodity financing during the year have not been without compensating benefits. On every hand is accumulating evidence that indicates that bankers are giving closer attention to this field and particularly to the character of collateral offered. More attention is being given to the laws under which receipts are issued and to the administration of such laws. There is need for greater supervision to protect warehousemen, depositors, and lending agencies from avoidable losses and unsound practices.

Regulations for field warehousemen were issued this year. For more than 6 years consideration had been given to this field. Wide variations in practice were found. The legal status of many field warehousing operations was questionable. Most bankers are unfamiliar with field warehousing, and many refused to accept field warehouse receipts. The regulations issued by the Department of Agriculture aim to place field warehouse receipts on a sound basis; they have been approved by leading bankers and various governmental financing agencies, including the Federal Reserve Board. They are the first really definite set of regulations in this field. Even though the warehouse operation is not licensed under the Federal Warehouse Act, many bankers are insisting upon a compliance with the principles and safeguards set forth in these regulations.

UNITED STATES GRAIN STANDARDS ACT

The United States Grain Standards Act was passed in 1916 and has been in force without amendments since that time. Its primary purposes are to establish uniform standards of quality and condition for grain for use throughout the United States and in foreign commerce; and to license grain inspectors to apply these standards, and to entertain Federal appeals from inspections performed by licensees, upon request of any interested party. Although the law is primarily service in character, it contains regulatory provisions designed to prevent fraud and misrepresentation in grain transactions and to promote fair dealing in the

industry. The official grain standards established under this act form an integral part of the marketing system in the movement of grain crops from producer to consumer through the various channels of transportation, warehousing, financing, future trading, milling, and exporting. The standards provide a common language for these operations supplemented by official unbiased inspection and grading.

At the close of the fiscal year there were 416 licensed grain inspectors in the United States, stationed at 169 inspection points in 33 States. The total volume of grain of all kinds inspected by these licensed inspectors under the act during the year was 1,160,435 car lots, or 1,537,478,000 bushels. Appeals were entertained and appeal inspections were made by Federal grain supervisors on approximately 7½ percent of the total volume of grain inspected. Appeal grades are used particularly in the grain movements via the Great Lakes and the rivers and canals, as well as in the coastwise movements, including those through the Panama Canal.

During the winter of 1932–33 a special and unofficial appeal grading service was conducted for the benefit of the American Red Cross on all wheat delivered to it by the Grain Stabilization Corporation for the purposes of unemployment relief. The inspection of all such wheat was supervised at the time of delivery, and the entire grain movement for this purpose was concluded in a most satisfactory manner. The Federal appeal service also established the grades on the major portion of approximately 9,000,000 bushels of Government-owned wheat delivered to the Brazilian Government in exchange for coffee.

In cooperation with the Food and Drug Administration, the Federal grain supervisors in the important grain markets assemble samples of damaged grain as well as evidences of adulterative practices. During the year 216 car lots and 6 barge lots of damaged grain were analyzed, and warnings were issued to the owners that such grain should not be mixed with sound grain. The prevention of grain adulteration by these methods is done in cooperation with organized grain exchanges to obviate violations of the Food and Drugs Act.

The official grain standards in effect during the year were those for shelled corn, wheat, oats, rye, grain sorghums, feed oats, mixed feed oats, and barley. The only change in these standards that was officially promulgated by the Secretary of Agriculture during the year was an amendment to the barley standards which established special grades for blight-damaged barley. A 4-year study of the grain standards, conducted for the purpose of bringing them into conformity with modern merchandising and processing practices, was completed. The resulting report in the form of Miscellaneous Publication No. 173, Proposed Revised Federal Grain Standards, has been issued.

Although the administrative procedure is somewhat settled as the result of 17 years' experience, new inspection problems continue to arise in connection with the changes in harvesting and merchandising methods. The grain trade is highly competitive in character, merchandising methods are complex, and notwithstanding the fact that the commercial inspection and grading of grain is not a precise science, producers and merchants demand and expect from a Government agency a degree of service of higher accuracy and efficiency than is attained by most commercial services. The task is a difficult one.

It has become apparent that the national grain-inspection program circumscribed by the provisions of the Grain Standards Act is inadequate in some respects to meet the modern and ever-changing conditions in the marketing and processing of grain. The demand for accurate inspection and for particularized information about grain quality increases each year, and it is increasingly difficult to meet these demands through an inspection system whereunder inspection is conducted by licensees of the Department, who are employed by States, grain exchanges, and boards of trade. Under the act there now prevails in numerous terminal markets what, in effect, amounts to a dual inspection service—a primary and required inspection by a licensed inspector, and a subsequent inspection made by the Federal Government as an appeal inspection by request of the shipper or receiver of grain. Under these conditions the repeated inspections and fees applied in many cases to car lots of grain moving to the ultimate consumer through several inspection points, and subject to numerous State laws, increase the costs of grain merchandising. Such repeated inspections also are a fertile source of intermarket grade variations under the national system of grain inspection governed by the Grain Standards Act.

MARKET-NEWS SERVICE

It is not too much to say that the Federal market-news service on farm products is unique. There is nothing quite comparable with it in any other country of the world. It supplies the producers, the distributors, and the public of the United States, daily, with the spot news of agricultural prices and markets; it functions with speed and precision roughly comparable to that supplied by the ticker service in the financial world; and it is relied upon by all parties as an unbiased, impartial, accurate source of information. In maintaining its market-news service, the Bureau last year operated about 10,000 miles of leased wire and maintained branch offices in most of the principal markets of the country.

THE EYES AND EARS OF THE AGRICULTURAL MARKETS

Last year was the eighteenth consecutive year of operation of the market-news service on fruits and vegetables. From Washington, and from the 22 market stations and 41 field offices which were operated last year, a steady stream of market news and other special reports was sent to all parts of the country. Something over 15,000,000 copies of such reports were issued, but this was a decrease of nearly 2,000,000 under those of the preceding year. The total number of names on all mailing lists was 81,704. Car-lot shipments of about 42 products were reported telegraphically by the carriers, and 4 additional products were reported by mail. Of these 46 products, all except 7 were covered by the daily market-news reports. Daily shipment reports were published on all of the 46 products.

The tobacco market-news service is intended primarily for the benefit of farmers. Nevertheless the reports are universally of such interest to the trade that members regularly visit the market-news offices or make sure that their names are placed on the mailing lists. Floor buyers usually obtain copies of the daily reports in the morning before the sale opens. The weekly reports are widely published in the tobacco trade journals. The tobacco market-news service was furnished this year in Virginia, North Carolina, South Carolina, Kentucky, and Tennessee.

In the case of cotton, daily telegraphic reports were received and disseminated from the important cotton centers in this country and weekly reports were sent in from the large cotton centers in France, Germany, England, and Italy. These reports contained current information on the state of demand for various grades and staples of cotton, premiums and discounts for grades and staples, quality sought and in supply, basic prices, fixations, and other pertinent factors regarding cotton marketing information required by producers, merchants, and others. The assembled data at Washington were reviewed and the more vital factors were embodied in a terse weekly market review which was transmitted by leased wire or commercial wire to the field offices by Saturday morning of each week.

FACTS IN A WORLD OF RUMOR

An interesting incident occurred during the national bank holiday (Mar. 6 to 16) which brought about a situation in the cotton markets probably without precedent in more than 60 years. The organized cotton markets in the United States found it necessary to close. The Liverpool and other foreign markets, however, continued business, and buying orders from foreign countries were reported to be plentiful in this country throughout the period. Business in American markets, therefore, although greatly restricted by the circumstances, continued in appreciable volume. A great demand arose for authentic market reports. The Division of Cotton Marketing immediately developed an emergency news service for the period of the banking holiday. Temporarily every field office was called upon to canvass its markets and to report by telegraph the qualities, prices, and number of bales sold each day. This telegraphic information was concentrated at Washington and was relayed by leased wire to points from which it was disseminated by telegraph and radio throughout the Cotton Belt. The Bureau files hold a large number of comments to the effect that these reports from a responsible Government agency, coming at a time when the markets were filled with rumors, were awaited in somewhat the same way as were various wartime communiqués.

Records show a steadily increasing use of the market reports covering dairy and poultry products. Not only market dealers and producers, but also officials, creameries, retail distributors, and other agencies are constantly requesting more information. New agencies, such as the State milk-control boards, are requiring more and more reports. Certain chain-store organizations state that they are

using these reports on trade output as one means of checking their own operations, and large buyers and processors of dairy products are using the reports in connection with the determination of price lists and in marketing operations. Certain newer items of the service, such as the weekly butter-production reports, weekly reports on receipts of eggs and poultry at midwestern packing plants, and shipments and receipts of eggs at Pacific coast points, have been particularly useful to concerns interested in those products.

The market-news service on livestock and meats, as the one on crops, came into being in response to the urgent needs of the industry itself. Prior to its inception a condition had developed in the livestock industry under which serious difficulties existed between stockmen and the market agencies that handled their stock. One of the chief complaints voiced by the stockmen was their inability to obtain prompt, accurate, and unbiased information regarding actual market conditions and prices on livestock and livestock products.

Although the market-news service varies according to the various commodity requirements, as will be apparent from the foregoing examples, the underlying purpose of the service is the same in all cases. It places the spot facts on supply, movement, prices, and related information almost instantly within reach of the persons who must have such facts. It functions from coast to coast and from border to border, with 10,000 miles of leased wire, branch offices in principal cities, and a staff of experienced observers and reporters.

The range and the capacity of the market-news service are greatly enhanced by the excellent cooperation received from the railroads, from distributors, warehousemen, and practically all those engaged in the agricultural trade. The almost universal attitude is that here is a business asset which both producers and public recognize and are willing to help make as complete as possible. It may be added that the expanding activities of the Agricultural Adjustment Administration cause the market-news service to be increasingly essential. It would seem scarcely possible to guide or influence the orderly distribution of farm products, according to any comprehensive plan, without having this daily spot news of shipments, movement, arrival, storage, prices, and related facts on a Nation-wide basis.

GENERAL ECONOMIC RESEARCH

Ecomomic research is the foundation on which is built practically all of our services in collecting and disseminating information respecting crops, livestock, and more general problems. Without adequate research it would be impossible to carry on the major lines for which this Bureau was established. Indeed, it would be impossible to meet the hundreds of problems that arise in the economic aspects of our agriculture. Research, in the sense that the word is here used, involves the study of specific commodity relationships—the investigation of production and marketing questions—and ranges to studies involving broad problems associated with the land and the farm population.

RESEARCH IN THE FIELD OF PRICE ANALYSIS

In all considerations affecting the income of agriculture and its relations with other economic groups the problem of price is of paramount importance. The Bureau has maintained a line of research in this field ever since its formation, but the work on these studies recently has been intensified in response to the urgent needs brought about by the depression.

Manifestly, the first requirement in such a research program is a background of statistical fact covering the developments of which the present situation is an outgrowth. Accordingly, during last year special effort has been made to bring this background material into such shape as would make it most valuable to governmental and other agencies charged with various responsibilities for an agricultural program. Crop-production statistics have been revised back to the date of the beginning of these estimates, this in itself representing a major piece of work. This revision will greatly improve the basis for analyzing the influence of prices upon acreage, yield, and production and the effect of variations in production upon prices of farm products in the United States. Data on world production are also being compiled and analyzed to show the effects of shifts and changes in world production on the prices of agricultural products, and the relation of the changes in production and prices to the kind and quantity the United States should produce.

The estimates of income from agriculture have been revised and improved during the year. This information likewise is basic to all measurement of the

economic position of farmers as a producing group. Gross farm income, which in 1919 amounted to nearly 17 billion dollars, fell to 9 billion in 1921, rose again to 12 billion in 1925, and then dropped to 5 billion last year. This strikingly outlines the course of the agricultural depression. Preliminary estimates indicate that the income will run to 6 billion for 1933. It is now possible to make a beginning toward estimating the monthly cash income from the sales of farm products for the country as a whole, and plans are being developed for such estimates by States and regions.

The effects upon agriculture of programs for the relief of other groups are important considerations. It is necessary to have an adequate current measure of farmers' expenses both of living and of production. Accordingly a revision was undertaken, this year, of the index number of prices that farmers pay for the principal articles they buy. This index has been made a better basis for determining price parities and changes in farm expenses. Incidentally, this revision has involved reorganizing the whole collection and compilation of data on prices paid by farmers.

The depression has intensified interest in the transportation service for agriculture and the rates or charges imposed upon farm products. As prices fall to depression levels, the maintenance of fixed transportation charges greatly disturbs the production and marketing of farm products. This fact has stimulated agricultural leaders to ask for readjustment in rates. The Bureau has contributed extensively to the preparation of data for use in rate hearings before the Interstate Commerce Commission. Upon request of the Commission an analysis of the general agricultural situation, showing the extent of the depression in the farm business, was presented in open hearings before it. Research in the relation of transportation services and rates to the production and marketing of farm products can be of great value in the reorganization of the Nation's transportation services and in developing policies respecting their relationship to agriculture.

Research is likewise contributing to an understanding of the significance of tariff rates upon products imported into this country and the possible effects of changing duties on imports. The relations between supplies produced in this country and prices, together with supplies and prices in foreign countries, have been analyzed to indicate the effectiveness of specific duties. Attempts have been made, furthermore, to determine the probable effect of reducing tariff duties in specific cases on production and consumption of a given farm product in this country; also the possible effect of changing a duty upon the production in specified foreign countries, and the imports from those countries into the United States. Conclusions based on such research have been utilized by those who are concerned with legislation and with negotiating treaties between the United States and foreign countries.

Special research services for specific agricultural industries have been maintained and developed insofar as possible. Important work has been done during the year in reorganizing and developing statistical services for the dairy industry. This has included new estimates of income for the dairy industry, and an analysis of factors affecting the prices, production, and consumption of dairy products. The results have been conveyed to representative groups in the dairy industry. Further research has been done in analyzing the competitive relations between the dairy industry in the United States and in important foreign producing countries. A study of international trade in butter and cheese has just been completed.

In regard to the particularly difficult situation in the canning industry, mentioned elsewhere in this report, it may be here noted that the Bureau collected and analyzed data on production, stocks, and prices of canned fruits and vegetables. The results of the analysis were taken directly to the industry and were utilized in developing its program for the present season.

Special research service was given to associations producing and marketing early potatoes. This showed the relation of local production to prices, the probable effect of prices upon production in the future, and the effect of the rate of movement to market upon prices. The experience in this case suggests the development of a similar service for other commodities, especially the perishable fruits and vegetables produced under highly specialized conditions and concentrated in a comparatively few local centers.

There is great need for the development of research data in the field of consumption and the effect of prices upon consumption. In administering the National Recovery Act and the Agricultural Adjustment Act, for example, it is necessary to consider the probable effects of the processing taxes and of any measures undertaken under the National Recovery Act that may affect prices,

upon the consumption of commodities and the distribution of income as between farm producers and other groups of producers. The Bureau is now assembling data on consumption, prices received by producers, wholesale prices, retail prices, wages and cost of services, with a view to determining what changes are taking place in the margins between producer and consumer and the causes of these changes, as well as their effects upon distribution and consumption.

FARM-CREDIT STUDIES

The Bureau conducts studies in the fields both of short-term and of long-term farm-mortgage credit. In some cases, the operating problems of the institutions that finance farmers are studied. The more important findings of studies completed during the year are as follows:

Since 1928 the farm-mortgage debt has decreased from about $9,468,000,000 to about $8,500,000,000. To a considerable extent, the reduction has resulted from an increasingly large number of foreclosures, but it is also due to the fact that new farm-mortgage loans have been made in smaller volume than formerly. Advances by 25 leading life-insurance companies averaged approximately $600,000 per week during the first 8 months of 1933 as compared with weekly averages of $3,000,000 from 1928 and 1930, inclusive; $2,000,000 in 1931; and $900,000 in 1932.

The total farm debt—mortgage and other—is estimated to be $12,000,000,000 or more. Annual interest charges on this debt are believed to fall between $800,000,000 and $900,000,000. In 1932 such charges absorbed approximately 16 percent of the total gross farm income.

Bankruptcies among farmers increased from 4,023 in the year ended June 30, 1931, to 4,849 in the year ended June 30, 1932. All sections participated in the increase except the East South Central States, the largest increase being in the East North Central States where the number of farm bankruptcies last year was 1,580 as compared with 1,025 in 1931.

A more complete statement on the farm-debt situation is available in House Document No. 9, 73d Congress, a special report prepared by the Bureau in response to a resolution of the House of Representatives. In addition, this report reviews plans adopted in other countries for relieving the mortgage situation and makes recommendations for readjusting the mortgage debt in this country.

Under the auspices of the National Land Use Planning Committee, an analysis was made of Federal seed-loan policies. The first Federal advances of this character were made in 1918, and since then advances have been made in 9 different years. Such advances amounted to approximately $64,000,000 in 1932, and $54,000,000 in 1933.

Advances for seed, feed, and similar items have been most numerous in the spring-wheat area of Montana and North Dakota, and in the cotton- and tobacco-producing sections of the Southeastern States. These sections were particularly in need of Federal assistance, owing mainly to unfavorable climatic conditions. Seed loans were used to finance, wholly or in part, the production of approximately 40 percent of the spring-wheat crop of the Northwest and 11 percent of the cotton and tobacco produced in the country in 1932.

Technical Bulletin 322, Agricultural Credit Corporations Affiliated with Cotton Cooperative Marketing Associations, was published in September 1932. Seventeen agricultural credit corporations have been organized since 1924 to act as financing affiliates for cotton-marketing associations. Only 5 of the 17 are now active; the rest were either forced to close or voluntarily ceased operations. As a general rule, such corporations were unable to escape large losses and their operating expenses consumed virtually all of their incomes. Moreover, they did not finance a large part of the cotton that was marketed through cooperative associations. Their new loans in 1930 amounted to about $7,000,000, but reached approximately $11,000,000 in 1931.

Such corporations did supply a needed financial service to farmers, however, and under better devised loan policies could serve a very useful purpose. Their adverse experience appears to have resulted from operating over too wide a territory to permit close supervision of loans, and from lending an amount which tended to reflect the gross return expected from a crop rather than the smaller amount actually needed by the borrower to produce his crop. More recent studies of small corporations in the St. Louis district indicate that cotton production can be financed with very small loss, even in a period of rapidly declining prices, if loans are made conservatively and are carefully supervised.

Several other studies are in progress, but results have not yet been published. One deals with agricultural credit corporations and livestock loan companies in

the St. Louis district. Another deals with country-bank policy in Arkansas A third is concerned with the financing of early potato production on the Eastern Shore of Virginia. A fourth reviews the history of farm bankruptcies under the National Bankruptcy Act of 1898 and deals especially with the recent amendment to this act.

RESEARCH IN FARM TAXATION

Two lines of action are essential to a fundamental improvement in the farm-tax situation. The first necessitates some redistribution of the tax burden. The second involves the selective reorganization of local governments and a realignment of local government functions to secure more economical use of funds.

In its research work respecting the first phase, the Bureau has completed a collection of annual data and computations of State and regional averages for farm real-estate taxes per acre covering the entire period since 1913. This collection gives a more adequate picture than has previously been available of the farm-tax situation during the last 20 years. The central fact is a rise of 141 percent in taxes per acre from 1913 to 1929. Although the acute distress among farm taxpayers has since forced substantial reductions, farm real-estate taxes in 1932 were still 89 percent higher than in 1913. The reduction has been very unevenly distributed among taxpayers and great numbers of individuals have obtained no reduction from the 1929 level. In three States even the State averages have not decreased. The ratio of property taxes to value of farm real estate in 1932 was nearly three times as great as in 1913. Since 1929, when farm taxes began to decline, the ratio of taxes to value increased 26 percent because the fall was more rapid in land values than in taxes.

With respect to the second phase mentioned above, local government and farm-tax studies have been carried on in cooperation with Minnesota, Kentucky, Louisiana, Montana, and Wisconsin. Reports have been published for the last three. The Wisconsin study estimated a possible 10 percent saving in government costs for a northern county and a farm-tax reduction possibly as great as 20 percent. The saving would result from substituting a county-unit school system for a district system, transferring all local road work to the county, and consolidating townships.

Both of the outlined fields of work require futher study, but investigations already made or under way have yielded important results. Farm taxpayers are struggling under an oppressive and unfair tax burden. Tax delinquency and tax sales are evidence of this distress. Two complementary means of relieving them are clearly indicated. One is a partial substitution of other taxes, principally the income tax, for the discriminatory general property tax (virtually a real-estate tax). The other is a selective reorganization of local government.

It is generally recognized that greater reliance on income taxation as a means of raising revenue to replace a part of the property tax is desirable. The Federal Government could aid in achieving this purpose by providing, in the Federal income tax, for offsets against State income taxes, analogous to the present offset in the Federal estate tax. Moreover, this should be conducive to greater uniformity in State income taxation. Since the Federal estate-tax offset was provided for, in 1926, 34 States have passed legislation to take full advantage of the offset allowed by the Federal Government. Should a similar provision be adopted with respect to the income tax, certain questions would arise as to Federal taxes and their coordination with State taxes—questions now of special importance, but beyond the scope of this report.

The Bureau's studies indicate that the more promising approach to local government reorganization in the interest of economy lies principally through educational work and sympathetic counsel in individual situations. Local governments cannot well be reorganized by broad groups, because many of them present special problems. The need in this field is for State and Federal assistance in the form of guidance and encouragement in studying possible increases in efficiency of local government in specific instances, and it is apparent that in order to effect real improvement in this field it is necessary to develop an informed public opinion along with fact finding and analysis.

SERVICES TO AGRICULTURAL INSURANCE COMPANIES

Work in agricultural insurance this year has consisted largely of meeting requests for advice on various problems that have confronted farmers' mutual insurance companies.

These companies have survived the economic depression in a gratifying manner. A few dissolutions have occurred, but in many States in which farmers' insurance

on a cooperative plan is well developed, not a single failure has occurred. Dissolutions of individual companies have taken the form of consolidations with stronger companies of the same class. Only in the one group of farmers' companies that specializes in the insurance of livestock against disease or accident, have the failures been relatively numerous.

The insurance work of the year has included further summaries of loss and expense statistics for farmers' mutual fire-insurance companies, and of data bearing on fire losses on farms, and the gathering of information on past and current activities of other classes of agricultural insurance companies, more especially of livestock-insurance companies at home and abroad. The annual fire losses on farm property has shown a distressing increase in the last few years, owing in part to physical deterioration of farm buildings and in part to economic stress affecting the usual hazard.

FARM-MANAGEMENT STUDIES TO INCREASE INCOMES

Continued low prices of agricultural commodities have increased the importance of studies on the business side of farming. Farm-management research is conducted to determine and evaluate the various types of farming in the country, and the farming systems and farm practices that will increase the farmers' incomes.

FARMERS' INCOMES

A survey of about 6,400 owner-operated farms shows that during 1932, after paying for current farm business expenses other than interest on debts and small amounts for improvements, an average cash balance of only $257 per farm was available for living expenses, payments on improvements, and indebtedness. But in addition these farmers had houses to live in and home-grown food for their families. In 1932 the cash balance was by far the lowest reported since 1929, when the average for 11,800 farms was $1,097. The decrease in cash balance during the 4 years, 1929–32, amounted to an average of $840 per farm studied, or 77 percent. During the same period, gross cash receipts decreased $1,655 per farm and cash outlay decreased $815 per farm.

The farmers' financial situation is not always clear to the city man, and in years of low industrial activity thousands of people with little or no farming experience seek advice from the Department concerning the possibilities of various agricultural ventures. To meet this situation, studies were made on the economic possibilities of small farms, to afford guidance to the prospective farm purchaser who wants a small farm for the support of his family, or for commercial purposes. It was found that one half acre of good land will produce the small vegetables, and that 1½ acres will grow all the vegetables and fruits needed by the average sized family. The advisability of keeping a small poultry flock, a few pigs, and a cow, as well as the maintenance needs of such livestock, and the amount of cash needed for operating the small subsistence farm were determined.

TYPE OF FARMING

Type-of-farming studies designed to determine the physical and economic factors that have shaped farming in each locality, and the trends of its development were pursued in nine States, each in cooperation with the respective State agricultural experiment station. Such studies are especially useful in programs of long-time agricultural readjustment. In Illinois, for example, agriculture is classified into distinctly different areas, or regions, traceable in part to market and transportation influences, for example, dairying near Chicago and St. Louis, and the truck crops near Chicago. Soil and topography account for the cash-grain areas and for the emphasis on livestock in other areas.

Some types of farming are particularly well adapted to the use of large-scale methods of operation. In a study of large-scale farming in the United States carried on jointly with the Bureau of the Census, it was found that of 7,875 farms classified as large scale, about 25 percent were fruit farms, and about 23 percent stock ranches. Five types—fruit, stock ranch, dairy, truck, and crop specialty—made up 78 percent of the total number of large-scale farms. Large-scale cash-grain, and cotton farms were relatively unimportant.

In periods when the farmers' purchasing power is low, it is of particular significance to consider the internal organization and operation of farms in terms of the crops and livestock produced, methods and practices employed, costs of production, and need for reorganization and improvement. Studies of this character were pursued in cooperation with State agricultural experiment stations in several

important areas devoted primarily to the production of cotton, early potatoes, grapes, apples, dairy products, corn and livestock, and honey.

In the Cumberland-Shenandoah section, for example, one apple producer received, over a 3-year period, 78 cents per barrel more for apples than was received as an average by a group of about 20 producers. A large part of this increase is attributed to better quality fruit obtained by more scientific practices in fertilizing, tilling, spraying, and grading and packing. The studies indicate that in the long run the extra expense was more than offset by the increase in yield and better average price received.

An example of the influence of marketing methods on farmers' returns is brought out in a study of the eastern grape situation. In 1928 growers who sold most of their grapes for truck shipment received 29 cents per hour for all labor spent on grapes as compared with 8 cents per hour received by growers who sold a large part of their crop to juice factories.

Choice of enterprises for cropping systems is illustrated by a study in farm practice with lespedeza. This crop fits readily into most of the well-established cropping systems of the area where it is commonly grown and can usually be included with little or no rearrangement of the other crops. Seeded early in the spring it will produce a crop of hay or seed the same year, and usually the shattered seed will come up and produce a crop the following year. Its use on run-down soils is highly recommended, since in many cases yields of corn, cotton, and small grains have been more than doubled at very little expense after lespedeza has occupied the land for from 1 to 3 years. In practically all farm-organization studies, high production per animal or per acre of land, and good management of the farm are associated with high net returns.

Studies of the relation of types of power to the amount of work to be done and the cost of performing different operations with different units of power and equipment were continued, in cooperation with State agricultural experiment stations and the Bureaus of Agricultural Engineering and Animal Industry. It was found, for example, that Montana farmers reduced their cost of fallowing $0.34 per acre by using the rod weeder in place of the duck-foot. This study and similar studies elsewhere indicate that substantial savings can be effected through proper adaptation of animal and mechanical power and equipment to the economic needs of the farm.

COST OF PRODUCTION

The data obtained on cost of producing cotton, corn, wheat, and oats were worked up in more detail than in previous years. The average cost of producing the 1932 corn crop, including land rent, was 49 cents per bushel. Wheat cost an average of 75 cents per bushel; oats, 36 cents per bushel; and cotton 9 cents per pound of lint. Excluding land rent, the costs were: Corn, 35 cents per bushel; wheat, 55 cents; oats, 24 cents; and cotton, 7.3 cents per pound. Acre costs were materially reduced below the costs of 1931, but because of lowered wheat yields, the bushel cost of wheat was only slightly lower in 1932 than in 1931. Bushel costs of corn and oats were substantially lower in 1932 than in 1931. The cost of producing a pound of cotton was about the same in both years.

ACTIVITIES IN THE FIELD OF LAND ECONOMICS

This Bureau has long urged the necessary of adopting a vigorous, consistent, and unified land policy that will give us a planned utilization of our land resources according to the uses for which our various types and grades of land are best fitted and with due regard to considerations of long-run public welfare. A land-use program for the Nation which involves a steady retirement of our poorest lands from agricultural production is now more imperative than ever. This is true because of our shrunken export market for certain farm products and because of the drastic slowing up in growth of population, not only here but in all the leading countries of the western world. Should the early and rapid decline of population in our large urban centers eventuate as now forecasted, this will have an important bearing upon the future of our domestic market for farm products and upon the use of the land.

During the last year the Bureau has actively aided the two Nation-wide committees (National Land-Use Planning Committee and the National Advisory and Legislative Committee on Land Use) devoted to promoting the adoption of a comprehensive program of land utilization. Such aid from the Bureau has taken the form of direct advisory work on the part of our staff and special studies regarding various aspects of land economics.

The ultimate application of an effective land-use program must be largely in terms of specific areas. This requires special study of the conditions, problems, and prospects of particular regions. Such a study was completed last year of land utilization in 13 hill towns of Vermont characterized by extensive farm abandonment. This study revealed clearly the waste and misery that attend the slow "natural adjustment" of an old settled area to the forces of decline and showed forcefully the need for a prompt and energetic program of reorganization with the help of the State.

An economic and social study of the southern Appalachian Mountain region was brought to completion during the year. This study, shortly to be published, has special value in connection with the Tennessee River development project since part of the area included covers roughly the upper half of the Tennessee River drainage basin. The fundamental problem for the 5 million people in the southern Appalachians is a problem of an overbalance of population in relation to the meager natural resources and opportunities.

Closely associated with studies like the foregoing are the land-settlement investigations. These are of particular importance now that continued unemployment and the growing drain on relief funds have turned the attention of governments, as well as individuals, back to the land. During the year a report entitled "State Land Settlement Problems and Policies" was completed which made available, for the first time, a summary and critical analysis of the experience of the various States in that field. This experience has not been a happy one and clearly suggests that land-settlement ventures must be selected and managed with unusual care if failure is to be avoided.

It may be said that the Bureau's work in this general field looks toward the ultimate retirement of submarginal land from agriculture. The presumption is that wise national policy will embrace the re-acquisition of much of this type of land either by the National Government or by local units. A definite beginning has been made during the year toward the delineation of various typical land areas within the country. A map was published showing the natural land-use areas of the United States with brief description of the characteristics of each. Estimation was made of the originally forested eastern half of the country, of the probable acreage of former farm land now available and to be available in the near future for forestry. A program has been inaugurated cooperatively with the Bureau of Chemistry and Soils and the various States for the complete classification and rating of the lands of the United States on the basis of their natural productiveness. Such tentative classification has been completed in 18 States and partially completed in 7 others.

FARM POPULATION MOVEMENT ANALYZED

Our population is highly mobile. There is constant interchange between farm and city. This Bureau attempts to determine as accurately as possible the changes in the number of persons living on farms year by year. It may be remarked, incidentally, that such information also furnishes a valuable basis for studies along collateral lines, such as the trend of consumption of crops and livestock products on farms, changes in the relative efficiency of human labor on farms, and changes in the demand for certain commodities and services by farm people.

Last year information for this study was obtained on more than 80,000 farms. It revealed that our farm population on January 1, 1933, was estimated at 32,242,000. This is the largest in the history of the country. During 1932 there was a net gain in the number of persons living on farms of slightly over 1,000,000. This, too, is the largest gain in a single year ever recorded by our annual estimates. In fact, substantial losses in farm population occurred practically every year from 1910 to 1930, but in the 3 years since the beginning of 1930 all of these previous decreases in farm population have been more than made up. These studies on farm population give a striking reflection of general economic condition since the World War. They reflect the agricultural depression and, more recently, the industrial depression with its unemployment and repercussions on agriculture.

A study was completed last year of the effect of typical rural industries upon the farmer's standard of living. Some 123 rural industries in 15 States were investigated to this end, including textiles, forest products, food and kindred products, stone, clay and glass products, machinery, chemicals, paper, etc. The number of persons living on farms and working in these industries, whole or part time, were 482 operators of farms and 3,692 members of the families of farmers. The average wages for the year earned in the rural industries by each

person to aid in the family living was $647 for males and $487 for females. In brief, this study indicated that the standards of living of farm people, both financial and nonfinancial, were very much increased by the employment of members of farm families in the industries.

RESEARCH IN THE FIELD OF MARKETING

There are many problems in the field of marketing farm products upon which research is essential. For example, the Federal standards for agricultural commodities require modification from time to time to meet the ever-changing practices in production, merchandising, storage, and processing. Standardization research, therefore, is one of the Bureau's important activities.

This year a long series of studies was brought to completion having the objective of improving the Federal standards for wheat, rye, corn, oats, feed oats, mixed feed oats, barley, and grain sorghums. Since grain standards were first promulgated in 1916 under the provisions of the Grain Standards Act, changes and additions have been made from time to time to keep pace with changing conditions in grain production, processing, and marketing. It is now proposed to make further improvement in correlating the standards with the increasingly complex methods of grain marketing, warehousing, and processing.

The Bureau has proceeded with great care in leading up to these proposals. For 2 years it has been making an experimental application of the proposed revised standards in the field offices of Federal grain supervision in order to check the inspection practicability of the proposed standards and to observe their effect on the grading of market receipts of grain. That the interests of various groups in the trade will not be affected adversely, the Bureau has printed these proposals in detail (Miscellaneous Publication 173) and has submitted them for a period of several months of public consideration. Opportunity is thus being given to producer organizations, the grain trade, grain processors, inspectors, and the State departments of agriculture and agricultural colleges to give thorough consideration to these proposals and to make constructive suggestions to the Bureau.

Research was undertaken during the year to provide official standards for malting barley. The demand for barley is increasing rapidly, with the result that material premiums are being paid for barley of malting quality. Incident to these barley investigations it was found necessary to develop some rather ingenious new equipment for the use of inspectors in the application of sizing specifications. A motor-driven continuous-flow sizing device was developed that will permit the inspectors to make the sizing determination in a very rapid and accurate manner. In these investigations it is hoped that sufficient data will be obtained from the 1933 crop to permit the formulation of standards for malting barley for use in the 1934 crop.

Research work has been inaugurated to develop a rapid method for the determination of oil content of flaxseed and soybeans. This test is important in the merchandising of these commodities for the reason that oil is the principal product from them. Oil testing of this sort has never been used in connection with the grading and merchandising of flaxseed and soybeans because no rapid, accurate test has been available.

The moisture content of grain is highly important in that it has a direct relation to the intrinsic value of any given lot of grain, and because it governs the keeping quality of grain in storage and during transportation. The Bureau has carried out extensive research work in an effort to perfect tests, using electric moisture testers, whereby the moisture in grain can be determined in half a minute, instead of half an hour, as now required with the Brown-Duvel moisture tester. The adoption of this new and rapid method, when completed, not only will effect great savings in the cost of grain inspection but also will vastly extend the use of moisture testing in inspection departments, country elevators, terminal elevators, and mills, as a measure of the grade and keeping qualitites of all kinds of grain.

STUDIES OF WEIGHT LOSSES IN TOBACCO

Research studies were inaugurated during the year to determine the character and extent of losses in weight sustained by leaf tobacco from the time it leaves the farmer's hands until manufacture. Losses in weight occur as a result of stemming operations and from cleaning, redrying, sweating, and long storage. They vary for the different types of tobacco and for specific types according to whether the tobacco is being prepared for domestic storage or export. The Bureau of Internal Revenue is looking to the results of these studies for basic information upon which

to modify, if necessary, certain of its regulations by which allowances are made to dealers and manufacturers for losses in weight of the tobacco for which they are held accountable. The information is also to be applied in assessing the processing taxes necessary under the Agricultural Adjustment Administration.

COTTON RESEARCH

The accumulation of great surpluses of cotton in the world has emphasized the importance of quality, as well as of price, in the competition of American cotton with that grown elsewhere. It is now clearly apparent that if our cotton is to retain its former prestige in the markets of the world, it must be bred and grown with the quality needs of consumers more definitely in view.

The Bureau has undertaken a series of researches designed to isolate and measure some of the more important factors of quality in terms of physical units and to evaluate their importance. This work is being carried on in the fiber laboratories at Washington, which are equipped with instruments for the precise measurement of such factors as length, length distribution, strength, fineness, color, and fiber structure. Through cooperative arrangements, intensive studies of fiber structure are being carried on in the laboratories of the Boyce Thompson Institute, while spinning investigations are being performed under a cooperative arrangement with Clemson College.

Because of the nature of the problem, many of these studies are necessarily of a continuing nature. They are constantly yielding, nevertheless, results of immediate application and value. For example, it has been known as a general rule that fineness in cotton fibers is associated with length of staple. Studies in our own laboratories within the year have gone further in showing the relationship of fiber fineness to the strength of yarns, strength being the principal criterion of yarn quality thus far developed. In these studies long-staple sea-island cotton, which possesses the greatest degree of fineness of any cotton, was cut into lengths to simulate $1\frac{5}{16}$- and 1-inch cotton of natural growth which are normally much less fine. The 22s yarn spun from 1-inch staple cut from sea-island cotton showed an average skein strength of 146 pounds, which is 51 percent higher than the average of a large number of American upland cottons naturally of this staple length and 27 percent higher than the strongest yarn ever manufactured from this staple length group at our spinning laboratory.

Another remarkable fact disclosed concerns the count to which cottons having the fineness of fiber of sea-island cotton can be spun. For instance, the four lots of $1\frac{5}{16}$-inch cut fiber were all satisfactorily spun into 60s yarn of very good strength, an achievement not recorded, so far as is known, with natural cottons of this staple length. It is possible that, with special care or technic, the mixtures could have been spun into even higher counts. The importance of these results is emphasized by the fact that natural cottons $1\frac{1}{8}$ or even $1\frac{3}{16}$ inches in staple length and of apparently good quality are frequently found which can be spun into 60s yarn only with difficulty. The significance of this information may be appreciated when it is realized that one of the major competing countries has made it a part of its national policy to achieve in its cottons those qualities which will yield a yarn strength 30 percent greater than can be attained with American cotton of like staple. This illustrates but one of the numerous problems and findings in our cotton work.

As methods of observation and analysis were developed in the fiber and spinning laboratories, they were found to have application to the problems of ginning. The annual loss of values in cotton through faulty ginning, estimated in excess of $25,000,000 a year, has been noted in earlier reports. To lay the foundation of knowledge for a program of action to reduce these losses is the purpose of the national ginning laboratory at Stoneville, Miss., in which this Bureau cooperates with the Bureau of Agricultural Engineering. Although the program of the ginning investigations is only well begun, the data so far obtained are leading to important improvements in gin design and operation. The process of drying seed cotton before ginning, developed in cooperation with the Bureau of Agricultural Engineering, was used on approximately 25,000 bales of the 1931 crop and 45,000 bales of the 1932 crop. The substantial increase in the number of bales ginned with this process indicates the favor with which it is being received. As a result of the use of this process upon wet cotton, it is conservatively estimated that the value of the cotton is increased from 60 cents to $5 a bale above the cost of drying. It is estimated, moreover, on a basis of the new drying installations that several hundred thousand bales will be artificially dried during the present season.

A factor of cotton quality of great importance is that of neps—small knotted masses of fiber found in badly ginned cotton. Heretofore little has been known of their origin or of the means of obviating their formation in ginning. A technic has been developed within the year for the classification of neps, naps, and seed-coat fragments. This is described in Technical Bulletin 396, Neps and Similar Imperfections in Cotton.

Studies of Cotton Prices in Local Markets

Studies of farm prices for cotton have definitely established the fact that prices received by growers do not reflect accurately differences in spinning value of different grades and staple lengths. During the 1932–33 season data on more than 30,000 individual bales and more than 50 local markets distributed throughout the Cotton Belt were collected and analyzed. It was found that prices paid to growers varied so irregularly on the basis of grade and staple length that it was not unusual for farmers to receive considerably higher prices for some grades and staples than other farmers received for higher grades and staples in the same markets on the same day. Average prices paid to growers were somewhat higher for the higher grades and longer staples than for the lower grades and shorter staples, but the average premiums and discounts for growers were considerably lower than those quoted in central markets. Thus the results of similar investigations during preceding years were confirmed. These variations are largely accounted for by a lack of knowledge of correct classification and commercial value among farmers and local cotton buyers and further point to the need of improved classification and market-news facilities in local markets.

Supplementing further the information secured in local markets, data were also collected at a number of points in west Texas and southwestern Oklahoma as a basis for determining the effects of methods of harvesting on the quality and price of cotton.

In addition, information was secured on cotton sold in the seed, during the season, in 13 local markets in Oklahoma, Missouri, Tennessee, and Arkansas as a basis for comparing prices received by growers for cotton sold in the seed with those for cotton sold as lint. The practice of selling cotton in the seed affects not only the ginner and grower but also the whole cotton industry, and a policy in respect to this practice should be determined in the light of the best interests of the public. Taking all factors into account, the conclusion was reached that from the standpoint of the public interest the disadvantages of the practice definitely outweigh its advantages.

Adaptation of Cotton to New and Extended Uses

Studies continued during the year, looking toward increased use of cotton in the form of consumer-sized bags for packaging fruits and vegetables, have resulted in considerable gains in the quantity of cotton used in this field. Trade estimates place the shipments of Florida oranges in 5-, 8-, and 10-pound cotton bags at more than 2,700 carloads, in addition to the use of approximately 2,000,000 cotton bags for packaging bulk shipments at destination. Considerable increases were also reported in the use of the duplex bag, developed by the Bureau, for the shipment of potatoes, onions, and walnuts. A cooperative association in an initial order used 400,000 of these duplex bags for the shipment of walnuts.

Cotton bagging for covering cotton bales has proved a suitable covering for transporting, for compressing, and for withstanding the strains of domestic and export shipment. For a complete appraisal of the usefulness of cotton bagging, however, it is necessary to ascertain the comparative resistance of cotton and other materials to exposure and the comparative protection to the contents of the bale. The Bureau, in cooperation with the textile school of the North Carolina State College of Agriculture and Engineering, has conducted studies and made tests to ascertain the weathering qualities of cotton bagging as compared with other types of covering materials for cotton bales. The results obtained to date are not conclusive, but the preliminary findings indicate that less fiber was damaged on bales covered with lightweight coverings than with the heavier jute coverings. The lightweight cotton coverings were, however, more susceptible to attack by bacteria and fungus growths. This experience has indicated the advisability of developing a treatment to render cotton bagging less susceptible to disintegration. Work of this nature is proceeding simultaneously with the continuation of the weathering test.

A study of the use of cotton in the sugar industry was begun and while an analysis of the data has not been completed, preliminary figures indicate that the

use of cotton in the form of cotton bags for containers of refined sugar furnishes a market for approximately 100,000 bales of cotton annually. The data also indicate that there has been a substantial gain in the use of the single 100-pound cotton bags as well as the introduction of the striped-sheeting bag for use as a cover for small cotton "pockets." The potential use of cotton in the form of cotton bags and filter cloth in the sugar industry is indicated to be about 190,000 bales.

DISTRIBUTION OF ECONOMIC INFORMATION

The events of the year with their widespread economic influences have created a demand for economic facts far exceeding anything in the past experience of the Bureau. Such calls upon the Bureau became increasingly urgent in the fall of 1932, continued to grow as the new agricultural policies began to be considered by Congress and the legislatures, and took on increasing intensity with the special session of Congress last spring. Following this period the organization of the several agencies having to do with agricultural relief and the newer projects for future planning have brought the information handled by this Bureau into a position of increasing importance.

To meet this far-reaching change, the information facilities of the Bureau have been taxed to the utmost to prepare the facts in forms that make them most useful for the large number of new workers engaged in planning further changes in national economic policies. In spite of the limitation of printing funds and facilities for mimeographing, the scope of distribution of the Bureau's material has been maintained in nearly all lines and even increased in some particulars. The regular periodical reports were continued during the year with but few changes and several notable special publications were issued having permanent value. Some of these have been referred to previously in this report.

The total number of printed publications issued by the Bureau last year increased slightly over those of the previous year, notwithstanding the reduction in the printing fund. Economies were effected primarily in reducing the size and editions of the publications. About the usual number of preliminary reports were issued in mimeographed form notwithstanding a reduction of about 40 percent in the paper allotment for the Bureau. Here again it was necessary to curtail the size of editions.

A special and unusual task handled by the Bureau this year was the preparation of exhibits for the Century of Progress Exposition at Chicago. A considerable amount of planning and work upon the Department's exhibit was centered in this Bureau and was carried through practically on schedule, with the result that the Departmental exhibit was one of the few governmental displays that was ready when the exposition opened in May.

The Bureau was called upon increasingly to handle special assignments for the preparation of special articles, charts, film strips, motion pictures, exhibits, and the like.

Through cooperation with the vocational teachers, publications of the Bureau have been introduced to thousands of students in the high schools and through them to their families, thus adding rapidly to the general spread of this type of economic information.

AGRICULTURAL ECONOMICS LIBRARY

The Bureau has developed one of the most comprehensive libraries in the world covering the literature of agricultural economics. During the year the library has made several significant contributions within its field. It maintained a monthly periodical which not only listed but also abstracted or reviewed practically all the important current publications in the field of agricultural economics. It compiled and issued 11 bibliographies covering various important economic subjects for which the reference demand has been unusually widespread. It perfected a system of current indexes and catalogs making the literature of this field more readily available to legislators and others having need for a rapid reference service.

U. S. GOVERNMENT PRINTING OFFICE: 1933

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REPORT OF THE CHIEF OF THE BUREAU OF AGRICULTURAL ENGINEERING, 1933

United States Department of Agriculture,
Bureau of Agricultural Engineering,
Washington, D.C., September 20, 1933.

Sir: I submit herewith the report of the Bureau of Agricultural Engineering for the fiscal year ended June 30, 1933.

Respectfully,

S. H. McCrory, *Chief.*

Hon. Henry A. Wallace,
Secretary of Agriculture.

The unfavorable situation with regard to prices of agricultural products has served to emphasize the necessity for reducing the cost of farm production. One of the principal objectives of the work of the Bureau of Agricultural Engineering has been to develop methods and equipment for lowering the cost of producing crops and livestock products, whether in the economical distribution and use of irrigation water, in the removal of stumps and wet spots that interfere with field cultivation and crop yields, in the prevention of soil losses by erosion, in the reduction of labor required for growing and harvesting crops and for handling livestock, in combating insect pests, or in the avoidance of losses in harvesting and in storage. With these researches there have been carried forward investigations as to labor-saving equipment and farmstead conveniences that will lessen the drudgery of farm work and make rural life more satisfying.

IRRIGATION INVESTIGATIONS

UTILIZATION OF WATER

That the economical use of water in irrigation must be based on the quantities required by the various crops under the different climatic and soil conditions was recognized in the beginning of the Department's irrigation investigations. That current practice was generally wasteful also was recognized, not only by the Department specialists, but also by the State agricultural colleges in those Western States where irrigation is general. Therefore the accumulation and collation of as much information as possible relating to the amounts of water actually applied to crops has been continuously one of the principal irrigation projects, in which the Department has had the cooperation of the agricultural experiment stations in most of those States. The reports of these studies have been issued, during the past 8 years, in a series of bulletins each dealing with the irrigation requirements of lands in one of the five major regions of the West—the Great Basin, the Missouri and Arkansas River Basins, the Southwest, the Columbia River Basin, and the Pacific slope basins. The last of these bulletins (Technical Bulletin 379) is now in press.

As the practice of irrigation has been extended, inevitably the available water supplies have been drawn upon more and more heavily. In many localities the normal flow of streams and the ground-water supplies have been so depleted that crop production is becoming unprofitable. The estimates of eventual profitable use of water, in the before-mentioned bulletins, are necessarily general and the irrigation requirements need to be determined in greater detail. Economical utilization of water requires also that diversion of part

of the supply be not permitted for unprofitable use. Therefore, although the general survey of irrigation requirements as a major project of the Bureau has been completed, studies in the utilization of water in irrigation are being continued along two general lines: (1) The water requirements of plant growths beneficial to man, and (2) the use of water by native plants of a noneconomic character.

CONSUMPTIVE USE BY CULTIVATED CROPS

The studies of water requirements of cultivated crops have been conducted during the year in a number of States, in cooperation with the agricultural experiment stations and with the Bureau of Plant Industry of the Department. In Arizona the experiments pertained to the requirements of citrus trees near Phoenix. In New Mexico experiments were made relative to the economical use and best methods of applying irrigation water to cotton on different soils. In California experiments have been made near Bard with respect to the requirements of cotton, alfalfa, and milo maize; in the Coachella Valley and at San Dimas with respect to subtropical fruits; in the Sacramento-San Joaquin delta with respect to asparagus; and in the San Joaquin Valley with respect to cotton. Inconclusive data for 1 year's study of the requirements of date palms, grapefruit trees, and grapevines were obtained in the Coachella Valley, before the studies were discontinued. In Oregon the investigations related to irrigation of pear orchards at Medford, and in Nebraska to the irrigation needs of sugar beets, potatoes, and alfalfa grown in rotation. At Brigham, Utah, the irrigation of stone fruits was studied on three characteristic soil types.

With respect to the consumptive use of water by plants, it has been demonstrated that practically the entire effective root zone of both field crops and fruit trees of all kinds is generally limited to the upper 6 feet of soil. Although the roots of many plants and trees may penetrate to greater depths, it is becoming increasingly clear that if conditions in the top 6 feet of soil are satisfactory, little or no attention need be given to supplying water below the 6-foot limit. Furthermore, if the top 3 feet of the 6-foot zone is kept sufficiently moist—in other words, receives its field capacity of water as needed—the lower 3 feet of the zone will require no special attention. The effective root action of many field crops and of citrus fruits is mainly limited to the top 2 feet of soil.

It has also been demonstrated that, in making soil-moisture studies, the moisture condition of each foot in depth must be obtained and considered separately. A test giving an average of 2, 3, 4, or more feet gives erroneous conclusions as to the efficacy of the soil moisture. For best results in irrigation it is not sufficient that the average soil moisture within the root zone be above the wilting point; this condition of moisture must prevail in all parts of the root zone, especially through the upper 4 feet. Soil-moisture studies must take into consideration also efficient root concentration, since rootlets and root hairs first exhaust the moisture of the soil in their immediate vicinity, and moisture from more remote particles of soil travels at rates increasingly slower as the distance becomes greater. It is concluded, therefore, that in general, during the period when crop plants are developing, the moisture content of the effective root zone (usually the top 2 or 3 feet) should be maintained at not less than 50 percent of its available-soil-moisture capacity.

CONSUMPTIVE USE BY NONECONOMIC GROWTHS

Within the past few years experiments have been begun in a number of localities to determine how much water is used by noneconomic growths. Extensive investigations were carried on in Santa Ana and the Mohave River areas, and at Coldwater and Devil Canyons in southern California. The plant growths especially studied in the Santa Ana and the Mohave River areas and the Coastal Plain were salt grass, Bermuda grass, tule, cattail, willow, and wire rush. Measurement was made also of evaporation losses from soils without vegetative growth in areas of high-water table. The investigations in Coldwater Canyon determined the use by the vegetation, chiefly alders and trees, in a defined section of the stream channel, and the yield of water from drained slopes on Arrowhead Mountain.

Tank tests of evaporation from bare soil of light texture showed that no evaporation occurred from undisturbed soil having a water table 4 feet below the surface. Tanks of undisturbed soil with a water table at 2 feet depth lost an average of 0.40 acre-inch per acre per month, while tanks filled with disturbed

soil having a water table 2 feet below the surface lost 1.60 acre-inches per acre per month.

Salt grass and Bermuda grass grown in tanks with the water table at 1-foot depth used water at the rate of 42.7 acre-inches per acre annually; at 2-foot depth, 36.2 acre-inches; and at 5-foot depth, 22.1 acre-inches, per acre per year. Tules grown in isolated tanks in many instances used an acre-inch or more per acre per 24 hours, and an extreme use of 3.6 acre-inches in 24 hours was recorded. Near Victorville, in a tank located in a swamp under conditions as nearly natural as could be made, they averaged for 2 years a use of 62 inches during May to October, inclusive, which was 55 percent more than the indicated evaporation from a lake surface. In densely grown natural-swamp areas tules may use not more than 30 percent as much water as when grown in isolated tanks. Willows used more water than the wild grasses with which tests were made. A single clump of willows used 52.7 acre-inches per acre per year with a water table 2 feet below the surface.

The investigations in southern California lead to the conclusions that (1) there will be no evaporation from light-textured soils when the water table is 4 feet below the ground surface, and very little when it is as low as 2 feet; (2) in general, evaporation from cultivated soils is small, and of little importance in comparison with the amounts transpired by the crops and weeds; (3) salt grass and Bermuda grass use about the same amount of water as cultivated crops grown under similar conditions; (4) although use of water by tules or cattails in tanks in exposed locations is not necessarily indicative of the use by such plants growing in their natural environment, these plants often occupy relatively narrow strips along the borders of canals and reservoirs and there they may use as much as 12 to 15 acre-feet per acre per season; (5) wire-rush growths use more water than either the wild grasses or willows where there is a high-water table.

The investigation in Coldwater Canyon showed a consumptive use by the native vegetation in the narrow, V-shaped lower section of the canyon of 72 acre-inches per 1,000 feet of canyon length, for the 6-month period from May to October 1932, which was at the rate of 64 acre-inches per acre of canyon-bottom fill. The loss in the upper section of the canyon during the same period was found to be 50 acre-inches per acre of canyon-bottom fill. Enough water was consumed during the growing season along each mile of canyon of the character of the lower section to meet the annual irrigation requirements of about 16 acres of citrus trees, and in each mile of the upper section enough to meet the irrigation requirements of about 11 acres of citrus trees.

The detailed report of these studies in southern California will be published by the California State Department of Public Works, which has cooperated in making the studies.

Tank experiments made in the Sacramento-San Joaquin delta during the year showed an annual use of water by cattails as high as 7.5 acre-feet per acre; by tules 8.63; by smartweed, 10.65, the average for 5 tanks being 9.70; by prickly lettuce, 8.31, the average for 5 tanks being 5.68; and by cockleburs, 7.24, the average for 5 tanks being 5.42. The water loss from 1 tank in which a mature nettle plant was growing was 8.24 acre-feet per acre. To appreciate the importance of such extravagant use of water, the amounts above given may be compared with the amounts used by asparagus during the same year—3.12 acre-feet per acre as the average for 4 tanks having the water table 2 feet from the surface, 2.11 acre-feet for 4 tanks having the water table 3 feet from the surface, and 2.08 acre-feet for 4 tanks having the water table 4 feet from the surface.

The estimated total amount used on waste areas in the deltas of the Sacramento and San Joaquin Rivers is 868,460 acre-feet, which would be sufficient to irrigate an additional area of economic growth amounting to probably more than 400,000 acres. Also, a very considerable part of the water now consumed on cultivated areas is used by the weeds that thrive between the crop plants. The weed growths that start up in the spring, grow through the summer, and mature in the fall interfere more with crop yields than do the winter weeds which mature early, or the late-season weeds. It has been found that proper regulation of the water supply, by keeping the surface as dry as is practicable after the root systems of the crop plants have become well developed, and especially at and after harvesting the crop, will control weed growth to a considerable degree.

RECLAMATION OF ALKALI LANDS

The experiments of the past year near Caldwell, Idaho, in cooperation with the Idaho Agricultural Experiment Station, have shown results similar to those of the prior years. In most cases lands that have become too strongly impregnated by alkali to produce crops profitably may be reclaimed by drainage and a proper use of irrigation water, but in the absence of good natural drainage the cost of such reclamation is greater than is warranted under existing agricultural conditions. The experiments have been discontinued.

DESIGN AND INVENTION OF APPARATUS

With the purpose of obtaining greater economy in construction of the Parshall measuring flume previously invented by engineers of the Bureau of Agricultural Engineering, tests on three small-size flumes have been made in cooperation with the Colorado Agricultural Experiment Station. It was determined that the diverging outlet section could be eliminated, at least in the sizes up to the largest tested, 3 feet in throat width, without causing material deviation in flow from that obtained with the previously adopted design. It appeared that the sloping floor of the throat must be retained, however, in order to stabilize the flow and maintain accuracy of measurement.

The private installations of the vortex-tube sand trap developed in cooperation with the Colorado Agricultural Experiment Station have been observed to operate successfully, and equipment has been installed in the laboratory to test experimental installations of large-size traps of this type.

UNDERGROUND STORAGE OF WATER

The experiments in spreading stream flow over certain areas of pervious soil in California, in order that the water may be held in the ground to be later recovered by pumping for irrigation, were continued through the year. The plots at Azusa were operated to study the rates of absorption as affected by physical treatment of the soil; by vegetation, silt, algae, and temperature; and by distance to ground-water table. It will be necessary to discontinue the studies at this location at the end of the next flood season, for lack of funds. The plot at Anaheim was designed to obtain a comparison of the sealing effect of a silt blanket with that of clean river sand, but continuance of the experiment depends upon obtaining funds for stripping the topsoil from the spreading area. Studies in the upper Santa Ana River spreading area will be undertaken in cooperation with San Bernardino County.

FLOOD CONTROL ON MOUNTAIN STREAMS

Study of the control of torrential floods in mountain streams has been continued and enlarged. A plan of control for Santa Clara River in Utah was prepared after a heavy flood in 1932 caused immense damage to lands along the stream. The plan called for straightening the channel and for installing dams and baffles to prevent further erosion under high banks. The plan was adopted by the stockholders of the irrigation company, work was begun immediately, and construction was 75 percent completed within a month.

IRRIGATION CUSTOMS, REGULATIONS, AND LAWS

The preparation of a bulletin regarding policies governing ownership of return waters from irrigation has been continued as opportunity presented, with the informal cooperation of various State and other agencies, but is not yet completed.

Plans for the rehabilitation of four irrigation districts in Nebraska and Oregon and of a drainage district in Oregon, that have become involved in financial difficulties, have been prepared or begun during the year, and advice given to several other districts in similar circumstances.

In connection with the work of the National Land-Use Planning Committee, suggested principles governing State legislation regarding the status, appropriation, and use of underground water were formulated.

SEWAGE IRRIGATION

Experiments in the utilization of sewage in irrigating crops have been continued at Vineland, N.J., in cooperation with the State agricultural experiment

station. Sewage irrigation has been practiced for decades by German and English cities and has been utilized to some extent by communities in southern California and Arizona. The borough of Vineland disposes of its sewage by irrigating a tract of coarse sand about 2½ miles from the borough. The cost of sewage disposal, exclusive of interest and depreciation on the plant, has been about $0.15 per person for Vineland, whereas costs have ranged from $0.51 to $1.21 per capita for nearby cities of about the same size utilizing other methods of sewage disposal and purification. Many crops, including alfalfa, corn, and other feed crops for livestock and poultry, have been grown successfully by using the sewage on the otherwise sterile sand.

DRAINAGE INVESTIGATIONS

HYDRAULIC EXPERIMENTS AT THE UNIVERSITY OF IOWA

The effect of bridge piers in obstructing flow of water in streams has been studied during the past 6 years by making some 2,600 tests on large-scale pier models under a more extensive range of conditions than has hitherto been attempted. The most efficient shapes of piers for different conditions of flow and the proper coefficients for the standard formulas have been determined as a result of this work. The practical application of these results will permit of a more accurate determination of increased flood heights due to bridges, and through improved pier design will permit smaller levees above bridges and less flooding of affected areas. A report covering the work has been prepared for publication by the cooperating institution, the University of Iowa.

The hydraulic losses in bends of various shapes in pipes of 6-inch inside diameter were determined experimentally. Tests of the 90° elbow of standard radius, bends of varying degrees of curvature, and special bends of various shapes have been completed. Preliminary results show that bends may be of use as flow meters, because of the constant pressure differential between the inside and the outside radii of the bend for the same quantity of flow. With velocities in the approach pipe high on the inner side and low on the outer side of the bend, the loss of head in the bend was about five times as great as when the distribution of velocities in the approach pipe was reversed. The results of these experiments will assist engineers in improving the efficiency of irrigation and drainage pumping plants, irrigation pipe lines, water supply and sewage systems for farm communities, and wherever pipe lines are built.

RUN-OFF INVESTIGATIONS

Valuable records of run-off were obtained in northwestern Ohio during the spring of 1933 when the stages of many creeks were unusually high. The studies were then discontinued because of reduced funds, but the data have been compiled and analyzed for the use of engineers in designing drainage channels. The run-off and ground-water studies in Ralston Creek watershed, comprising about 3 square miles in eastern Iowa, begun in 1922, have been continued in cooperation with the University of Iowa. A summary of the results has been completed and includes data on maximum rates of run-off during storm periods. The effect of vegetation on amount and intensity of run-off has been determined by yearly crop surveys. Rates of infiltration and fluctuation of ground-water levels were determined accurately by the readings of wells. During 1925 to 1931 the annual precipitation varied from 28.96 to 39.97 inches and the annual run-off from 2.76 to 13.34 inches.

DURABILITY OF DRAINTILE

The investigations carried on for some years in cooperation with the University of Minnesota and the Minnesota Department of Conservation now make it possible to draw certain specific conclusions relative to the durability of concrete tile for use in soils containing alkalies of the sulphate type, particularly the sulphates of magnesium and sodium. Technical Bulletin 358, Laboratory and Field Tests of Concrete Exposed to the Action of Sulphate Waters, was issued in June 1933.

Only cements above the average in resistance should be used in the manufacture of concrete tile to be installed where sulphates are present. The resistance of a cement from any plant is fairly constant. The 28-day strength has much value as an index of permeability and sulphate resistance, particularly with rich mixtures. Concrete should be kept from contact with sul-

phates until it has had an opportunity to harden in air for 30 days if possible—90 days is yet better. Steam curing when 12 to 24 hours old at temperatures of 212° F. or higher for 48 hours or longer is desirable. Alumina cement may be used advantageously for structures subject to severe conditions of sulphate exposure, if the concrete will be continuously moist at temperatures generally below 60° and rarely exceeding 70° F. These conditions are about average for draintile after installation.

DRAINAGE OF SUGARCANE LANDS

Experimental plots of plant cane drained by ditches 6 feet deep outyielded similar plots drained by ditches only 3 feet deep, by 2.7 tons of cane per acre and 211 pounds of sugar per acre in 1932, and plant cane and stubble plots drained by ditches 6 feet deep outyielded similar plots drained by 3-foot ditches by 1.8 tons of cane per acre and 274 pounds of sugar per acre. Tile-drainage and irrigation experiments yielded inconclusive results in 1932. Irrigation was apparently unnecessary in Louisiana in 1932, as frequently happens. A deficiency of rainfall occurred during the early growing season of 1933 and on July 6 the P.O.J. 213 cane on the irrigated plots was 0.8 foot higher and looked healthier than that on the check plots.

MAINTENANCE OF DRAINAGE DITCHES

Open drainage ditches deteriorate rapidly through the accumulation of silt and debris and the growth of weeds and brush in the channel. An investigation of ditch-cleaning methods and cost was begun in Kent County, Del., in 1931 in cooperation with the State highway commission, to determine the economical limits of cleaning ditches by ordinary methods, to develop more economical methods, and if possible to design better maintenance equipment. The study has been discontinued because of lack of funds, and a progress report has been prepared covering the work done.

It appears that, with wages at 30 cents per hour, hand labor is too expensive to employ on ditching jobs of any magnitude. Team-and-scraper work was also found to be too expensive for cleaning ditches with wet bottoms, the excavation cost being about 60 cents per cubic yard for digging to a depth of about 1 foot from a ditch about 5.5 feet deep and 20 feet in top width. A tractor-and-scoop ditch-cleaning outfit was designed and used successfully. The cost of excavation averaged 24 to 26 cents per cubic yard with this equipment. Standard drag-line excavators were most economical for construction work having large yardage and favorable operating conditions. With ½-yard and ¾-yard machines, the cost averaged 8 to 9 cents per cubic yard, for excavation 3 to 5 feet deep and 16 to 28 feet wide. The cost of using a drag-line for light work has been found prohibitive in many instances because of the time required in scraping and trimming to fill the bucket and in moving the machine. Use of dynamite was very economical for small jobs, such as blasting out widely separated bars and excavating shallow intermediate cuts. Excavating costs ranged from 16 to 30 cents per cubic yard for blasting in sand when efficient loading methods were used.

CONTROL OF GROUND WATER IN PEAT AND MUCK SOILS

The studies of means and costs of controlling the ground water in the peat and muck soils of Florida were continued at Belle Glade, in cooperation with the State agricultural experiment station. Capillary movement of soil water is limited to an unusually narrow range in these soils. Prevention of ground-water fluctuations is especially important for the costly shallow-rooted truck crops commonly grown on those lands. Experimental equipment has been installed and some results of value obtained during the first year, but final conclusions must await results from several years' work. To study the effects of different types and depths of drainage, a 10-acre pasture has been underdrained with lines of clay tile, cypress boxes, and mole drains 24 to 42 inches deep. The mole drains were made by drawing a 6-inch steel torpedo through the soil. Thus far they have remained fairly clean where above the ground-water level, but considerable filling has occurred below the level. A portable pump will be used to control the water level in the outlet ditch. Wells have been installed to permit observation of the effects of rainfall and of pumping on the ground-water table in the pasture.

DRAINAGE OF LANDS OVERLYING AN ARTESIAN GROUND-WATER RESERVOIR

Investigations in relation to this problem, carried on in the Cache Valley artesian basin in Utah in cooperation with the Utah Agricultural Experiment Station, have demonstrated the feasibility of relieving the water pressure by means of deep surface drains, of numerous wells driven in the bottoms of the drains to the water-bearing material, or the adequate use of pumps. A report of results obtained has been prepared for publication by the station. Details of the problem are receiving further study.

DRAINAGE INDEX OF SOILS

A laboratory study was undertaken a few years ago to develop a method whereby simple field or laboratory tests of a soil to be drained would show the proper depth and spacing for the drains. Results were obtained which will be of great help to future research workers on this problem, but the economy program has made it necessary to discontinue the investigation before a satisfactory index was discovered.

Elutriation is a water separation of the grains of a soil mass into size groups, which has been used in Europe for estimating drainage characteristics. It is apparently applicable to only a part of the range of possible soil conditions in the United States. Used, however, in classifying for valuation purposes a number of typical tile-drained soils in the Mississippi Valley, it gave an orderly basic classification that was of assistance to the appraisers. The capillary lifting power of a soil seems to offer considerable promise as a means of rating the drainage characteristics. It automatically incorporates the effects of all variations in soil-grain sizes, even in very fine-grained soils, but the elutriation method does not separate sizes below 0.02-mm diameter. A new method of packing powdered or sifted soil uniformly into a tube to form a homogeneous mass for the accurate measurement of capillary movements was developed.

OPERATION OF DRAINAGE PUMPING PLANTS

Studies of pumping for drainage were limited to obtaining records from pumping plants along the Illinois and upper Mississippi Rivers, primarily for determining the amounts of seepage water from the river that must be pumped. Technical Bulletin 327 Cost of Pumping for Drainage in the Upper Mississippi Valley, was printed during the year, and the manuscript for a technical bulletin on the Design and Operation of Drainage Pumping Plants, presenting the results of a 6-year study in the upper Mississippi Valley, has been sent to the printer.

DRAINAGE DISTRICT OPERATION

The study of drainage districts to determine what factors affect their success and failure was continued on pumping districts in Illinois, Iowa, and Missouri, and on gravity districts in Iowa and Minnesota.

The financial condition was determined for 49 pumping districts embracing 367,551 assessed acres in 1932. Of the districts studied, only 2 had paid off their entire indebtedness, 12 districts had $1,050,087 bonds outstanding but had paid interest and principal in full to date, and the other 35 districts had $6,503,348 outstanding bonded indebtedness and were in default on bond or interest payments. Outstanding bonded indebtedness per acre averaged $10.94 for the districts not in default, and $23.94 for those that were in default. Most of the latter districts had met all their maturing obligations prior to 1929, while prices of farm products were normal, but some that had been constructed during the war period at excessive cost had been in default for several years. Inadequate interior drainage, failure of levees during high-water periods, and inadequate or uneconomical pumping plants were other causes contributing to defaults.

Gravity districts were studied in the glaciated counties of north-central Iowa and southern Minnesota. Outstanding bonded indebtedness at the time of examination averaged about $4 per acre in Iowa and $5 per acre in Minnesota. In the latter State none of the outstanding bonds was in default, because the counties collect the drainage taxes and guarantee the bonds. In Iowa, 2 out of 10 districts studied in detail were in default on bonded indebtedness. The outstanding bonds of the districts in default averaged about $9 per acre.

A plan for rehabilitation of one of the largest drainage districts in the United States was prepared during the year, as an example of how such

financial difficulties could be settled. The plan provides that each year the annual drainage-tax levies shall be based on the crop yields and farm prices received in the district, and that after necessary operation and maintenance expenses have been deducted the remainder will be accepted by the bondholders in full for the obligations maturing that year. Thus in years when the land receives large income from the crops, large payments can be made on bonded indebtedness, while in years of low income small payments are required. The available information indicates that it is more profitable for bondholders to accept a reduction in face value of their securities and for landowners to make the financial sacrifices necessary to effect a compromise, than to permit the drainage improvements to become ineffective.

SOIL-EROSION CONTROL

Studies of hillside drainage to control erosion on farm land were begun in the Office of Experiment Stations in 1903. A carefully planned field investigation of terracing to prevent the enormous losses resulting from soil erosion was undertaken in 1914 and has been continued to the present time under the Bureau of Public Roads and the Bureau of Agricultural Engineering. Results of these investigations have been published by the Department in several technical and popular bulletins. At the Department's soil-erosion experiment stations it has been demonstrated that terraces, properly laid out and built, are an effective and practical method of controlling soil erosion on cultivated land.

The Congress in 1929 specifically authorized the Secretary of Agriculture to undertake a comprehensive investigation of soil erosion, its control and prevention. The work was apportioned by the Secretary to the Forest Service, the Bureau of Chemistry and Soils, and the Bureau of Agricultural Engineering. To the first was assigned the studies relating to the national forests, and to the others the studies relating to the farm lands of the Nation. With the funds provided, 10 soil-erosion experiment farms have been established, at which the Bureaus of Agricultural Engineering and of Chemistry and Soils and the State agricultural experiment stations are conducting cooperative experiments in erosion-control methods. The farms comprise from 140 to 300 acres each and represent wide differences in soil, climate, topography, and farming conditions and practices. The first of these farms was established in 1929 at Guthrie, Okla. The others, in order of establishment, are located at Temple, Tex.; Hays, Kans.; Tyler, Tex.; Bethany, Mo.; Statesville, N.C.; Pullman, Wash.; Clarinda, Iowa; La Crosse, Wis.; and Zanesville, Ohio.

The Bureau of Agricultural Engineering is studying the application of engineering principles to the problems of soil conservation. The major factors in causing erosion are the velocity and volume of surface run-off and the character and condition of the soil. Erosion could be prevented by reducing the velocity of run-off below that which will cause erosion. Removal of water at limited velocities and the determination of the limits are problems of hydraulics. Practical erosion control, however, is not merely a matter of preventing loss of soil from the fields, but of doing it in such a way that the lands may be maintained in profitable production. Retardation of the rate of run-off not only reduces the amount of erosion, but also increases the amount of water absorbed by the soil which in some regions is materially beneficial to crops. The purpose of the agricultural engineers is to determine how engineering methods can most efficiently control soil erosion, either unaided or in combination with agronomic methods which are being studied by the Bureau of Chemistry and Soils.

The objects of the engineering investigations on the erosion-experiment farms are (1) to determine the water-carrying capacity of terraces for different soils and land slopes, and the required carrying capacity according to the fall, vertical spacing, and length of terraces; (2) to determine the effectiveness of terraces in preventing erosion and conserving moisture, by comparing water run-off and soil losses on terraced and unterraced land; (3) to develop the most economical methods of constructing and maintaining terraces under different farming conditions and practices; (4) to determine the best available machinery for building terraces, and to design better machinery for the purpose; (5) to study the operation of various types of farm machines over terraced land, with a view to recommending changes in design to improve their operation; and (6) to improve the design and construction and to reduce the cost of various types of check and soil-saving dams for controlling erosion in gullies, terrace outlets, and road ditches.

TERRACES AS CONSERVERS OF SOIL

The effectiveness of terraces in reducing soil losses has been conclusively demonstrated at several of the soil-erosion stations. On the Red Plains station at Guthrie the soil losses from an unterraced area in 2 years averaged 66 tons per acre per year, whereas the average was 2.65 tons per acre from a terraced area similarly cropped, the average rainfall for the period being about normal. On the experiment farm at La Crosse, while terraced land planted to barley lost less than 150 pounds per acre during two rains totaling about 3½ inches, the loss from unterraced land similarly cropped was 7,120 pounds per acre, or more than 49 times as much. On land planted to wheat at the Bethany station, soil losses during one rain of 1.17 inches were only 60 pounds per acre from a terraced area, and 2,100 pounds per acre, or 35 times as much, from an unterraced area.

ECONOMY OF TERRACING NEWLY BROKEN LAND

The rapid depletion of fertility of the soil on the Guthrie farm due to erosion was manifest from a comparison of crop yields obtained on virgin land (land first broken after the station was established), with those obtained on badly eroded land that had been cultivated more than 30 years. More than 40 bushels of oats per acre were produced on the virgin land, and only about 15 bushels per acre on the badly eroded land. By actual measurement, the soil loss from terraced areas of the badly eroded land was nearly twice as great as from the terraced virgin land, and by actual records the cost of building terraces on the badly gullied land was more than six times as much as on the virgin land, on which no gullies had developed. These results demonstrate that it is advisable to start the erosion-control work when the land is first broken, rather than to wait until erosion has begun. Early terracing insures lower cost per acre and helps greatly in maintaining crop yields. The lower cost on newly broken land results from fewer crossings of gullies, where high terrace banks are necessary, and from a somewhat wider spacing of the terraces permissible on smooth slopes.

SOIL LOSSES ON MODERATE SLOPES

The rather general idea that soil erosion is confined largely to the steeper land slopes, and that therefore preventive measures are unnecessary on moderately sloping land, is controverted by data collected on the Oklahoma experiment station near Ardmore. Run-off and soil losses from an unterraced land slope of 1.9 percent were measured. A rain of 6.1 inches caused a loss of approximately 11.1 tons of soil per acre. Comparison of this with the loss of 14.5 tons per acre by a 3-inch rain on a slope of 5.1 percent at the Guthrie farm makes it evident that soil erosion may be indeed a serious problem even on land slopes as small as 2 percent.

EFFECT OF TERRACE GRADE ON SOIL LOSSES

The effect of fall or grade of terrace upon soil losses was plainly demonstrated in experiments at the Guthrie and Bethany farms. In an experiment on the Guthrie farm where the terrace grades were 0, 2, 4, and 6 inches per 100 feet, soil losses were 2.65, 4.63, 5.29, and 10.26 tons per acres, respectively. The terrace with 6-inch grade lost about four times as much soil as the level terrace and about twice as much as the terraces with 2- and 4-inch grades. Similar experiments at Bethany showed soil losses increasing from 0.63 to 7.27 tons per acre for terraces having grades of 0, 2, 4, 6, and 8 inches per 100 feet. Appreciable scouring in the channels was evident with the 6- and 8-inch grades, at both Guthrie and Bethany. At Guthrie, in both 1931 and 1932, the yields of cotton and corn on the plots with the level terraces and with those having the 6-inch grade were less than where 2-inch and 4-inch grades were used. The yield was smaller in the level terrace channel because of partial drowning of the crop, and in the terrace channel with 6-inch grade because some of the small plants were washed out by the high velocity of the water. Sufficient grade should be given a terrace to drain the terrace channel satisfactorily, but not great enough to cause appreciable erosion.

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VARIABLE VERSUS UNIFORM GRADES FOR TERRACES

To compare the effectiveness of terraces having uniform grades throughout their length with that of terraces having variable grades increasing from the upper to the outlet ends, experiments are being conducted at a number of the erosion stations. The principle of the variable-grade terrace is that a small grade at the upper end tends to hold back the flow there until the water below, where the grade is greater, has a chance to get away. This reduces concentration of the run-off near the outlet end of the terrace and thus lessens the likelihood of breaking the terrace.

From two terraces 700 feet long on the experiment farm at Tyler, one with uniform grade of 6 inches per 100 feet and the other with grade varying from 0 to 6 inches per 100 feet, the average losses were, respectively, 7.95 and 6.8 tons of soil per acre annually for 2 years. The loss with the uniform-grade terrace was 17 percent more than with the variable-grade terrace. With two other terraces 1,700 feet long, one uniformly graded 3 inches per 100 feet and the other variably graded from 0 to 3 inches per 100 feet, the average losses were 5.15 tons and 4.15 tons of soil per acre per year, respectively, the uniform-grade terrace losing 24 percent more than the other. On the Bethany experiment farm, a terrace with uniform grade of 4 inches per 100 feet lost 31 percent more soil than did a terrace with variable grade of 1 to 4 inches per 100 feet. This consistent finding of soil losses smaller with variable than with uniform grades indicates that generally the variable grade is to be preferred.

LEVEL TERRACES

Experiments at Tyler, Temple, Guthrie, and Bethany with level terraces that retained all of the rain above them in order to increase the supply of moisture for crops indicate that this practice is not advisable in regions of tight soils. Although level terraces have increased crop yields 25 to 40 percent on open soils in western Texas and Oklahoma, at Spur and Ardmore, respectively, on the Guthrie farm water standing above level terraces decreased the yield of an oats crop 60 percent, and at the Tyler, Temple, and Bethany stations similar results were obtained. Experiments with level terraces are included in the programs of all the erosion-experiment farms, and the data obtained will afford also comparisons of the rates of percolation of water into the different soils. It is anticipated that ultimately recommendation can be made as to the suitability of level terraces for many different regions and locations.

SHORT VERSUS LONG TERRACES

Long terraces showed greater soil losses than short terraces on the Tyler farm. A terrace 700 feet long with a vertical spacing of 4 feet and a uniform grade of 3 inches per 100 feet showed an average annual soil loss for 2 years of 3.55 tons per acre, whereas the loss was 4.85 tons per acre from a terrace 1,700 feet long with the same spacing and grade. Doubtless the greater volume of water in the channels of the longer terraces causes more erosion and carries away more of the soil that has been moved down the slope into the terrace channels. It appears that short terraces are to be preferred to long terraces.

EFFECT OF VARYING TERRACE SPACING

In an experiment at Tyler, three terraces 1,700 feet long with vertical spacings of 3, 4, and 5 feet on land planted to cotton and corn for two successive years gave average annual soil losses of 3.17, 4.83, and 5.16 tons per acre, respectively. Terraces 700 feet long, however, on lands planted to cultivated crops showed no great differences in amounts of soil lost with different vertical spacings. At Bethany, two sets of terraces, 700 and 1,040 feet long, respectively, in cultivated fields showed no marked differences in soil loss with different spacings. On the Guthrie farm, terraces 700 feet long with spacings of 2, 3½, and 5 feet on cornland in 1931 lost 2.74, 3.96, and 4.98 tons of soil per acre, respectively. The next year the same land was planted to oats, and the soil losses were practically alike for the three spacings. With the wider spacing small gullies developed when the land was in corn but not when it was in oats.

The results obtained at Guthrie seem to indicate that the soil losses increase with the spacing of terraces when the ground is bare, fallow, or in clean-

cultivated row crops but are not much affected by the spacing on land in close-growing grain crops. The condition of the terraces and terraced fields on the Guthrie farm are fairly uniform, and the results were obtained from duplicated experiments, so more weight is given to those than to the experiments at the other stations established more recently. The condition of well-maintained terraces becomes more uniform with use of the land, and it is felt that further time and additional data will be required before the experiments at Tyler and Bethany will be definitely indicative of what may be expected on those farms.

TERRACING STEEP SLOPES

It has generally been considered inadvisable, even with terracing, to cultivate slopes greater than 12 to 15 percent. However, on several of the erosion-experiment farms much steeper lands have been terraced in order to obtain definite information as to the maximum land slopes on which terraces may be effective. On the experiment farm at LaCrosse, cultivated slopes of 25 percent and pasture slopes of 30 percent have been terraced, with results so far very satisfactory. At the Pullman experiment farm, in the Palouse district, cultivated slopes as high as 40 percent have been terraced, but in that area rains generally are light and much of the erosion is caused by melting snows, and steeper slopes can be cultivated there than in the Middle West.

MACHINERY ON TERRACED LAND

Where single-row horse-drawn implements are used, there is no appreciable difficulty in operating the equipment on slopes as steep as are commonly cultivated, especially if the farming operations are conducted parallel to the terraces. Where multiple-row tractor-drawn machinery is used, the problem of adjusting the machinery and terraces to each other is somewhat difficult. On the more moderate slopes, the crossing of terraces with large machinery is common; on the steeper slopes, farming operations are generally conducted parallel to the terraces, although some farmers lay out the crop rows regardless of land slope. Where wheat is the principal crop and large combines are in general use, terracing is not yet generally practiced; and in the few localities where it is practiced, the farming operations do not follow the direction of the terraces except accidentally.

Studies of the operation of farm machinery on terraced land are being made on several of the Department's soil-erosion experiment farms. It has been observed that terracing often improves fields for the operation of farm machinery by making the surface smoother. Gullied fields often must be farmed in parts because the gullies cannot be safely crossed with machinery. The land in such a gully and a strip on each side cannot be successfully farmed. Terracing such a field reclaims all of the land for cultivation and facilitates the satisfactory use of farm machinery.

CHECK DAMS FOR GULLY CONTROL

A large number of check dams of various types have been built in gullies on the erosion-experiment farms to check erosion and to cause filling of the gullies with sediment. Observations indicate that unless such dams are properly constructed, unsatisfactory results follow. As a result of these observations, special attention is called to the following important points in the construction of check dams:

The reduction in cross-section area of the gully should not be so great as to cause the run-off water to overflow the banks of the gully and erode around the ends of the dam or develop a new gully paralleling the old one.

The ends of a check dam of watertight construction should extend far enough into the gully banks to prevent water seeping around the dam and washing away the side of the gully.

The foundation of the dam should extend far enough below the bottom of the gully that hydraulic pressure will not force water under the dam and, by undermining, destroy the structure.

The top of the dam should be low enough in the middle and high enough at the banks that the water flowing down the gully will never get so high as the ends of the dam.

An apron should be provided on the floor of the gully at the lower side of the dam sufficiently long and wide to prevent any erosion or undermining of the dam by the water dropping over.

FARM-LAND DEVELOPMENT INVESTIGATIONS

The investigation to determine the engineering improvements needed on typical farms and the benefits to be obtained by making them has been expanded during the year to include 10 more farms. Detailed surveys of 85 farms in five States have now been completed, and in cooperation with the State agricultural colleges a complete farming program has been developed for each. In these programs, every phase of the farm business is considered, and each element—crops, livestock, fields, machinery, and buildings—is properly proportioned to the others and to the farm business as a whole. As the farmer carries out the program, the resulting benefits are being determined from the farm-income records.

One of the Virginia farms recently surveyed furnishes a good example of the scope of this project. It is situated in hilly country and has 28 acres in mature apple orchard, 12 acres in young trees, and 23 acres in hay and feed crops. The livestock consists of 3 horses, 6 cows, and 80 hens. The machinery was appraised at $1,000 and includes a tractor. The orchard was rented out on a share-crop basis. The farming program called for the installation of a stationary spray plant and an irrigation system in the orchards, and change from the leasing system to operation with hired labor because of the reduction in labor made possible by the stationary spray system. It was recommended that the number of cows be reduced to 2 and the number of hens increased to 500, to obtain a better balance in the farm business. Drainage improvements in the creek bottoms were recommended to enlarge and improve the crop acreage so that enough feed for the livestock could be raised on the place. Plans for remodeling and increasing the capacity of the present poultry houses are included. The soil survey, which was part of the preliminary farm survey, disclosed that one field, not now in use, has a soil especially suited for growing peaches. Therefore it was recommended that peach trees be set out on that land, as a means of further balancing the business and of extending the income over a longer period. Sufficient time has not elapsed for all these recommendations to be carried out, and the benefits cannot yet be measured, but the orchard irrigation system and the stationary spray plant have been installed and the apples produced are larger and of better color and quality. Because of the saving in labor by use of the central spray system, the orchard now is being operated with hired labor instead of being leased, and the change promises to be very profitable.

The plans recommended for different farms necessarily vary with the type of farm, the present practices and equipment, and the soils, climate, and markets. Every effort is made to keep the development plans practical and within the capabilities and means of the individual farmers. Although economic conditions since this project was started have not been such as to encourage landowners to improve their farms or equipment, the owners of all the farms surveyed have expressed great interest in the plans prepared for them, and many have made considerable progress in making the improvements recommended.

EMERGENCY CONSERVATION WORK

The Bureau of Agricultural Engineering is participating in the national emergency relief work by assisting the Forest Service in supervision of certain phases of the flood-control work undertaken by the Civilian Conservation Corps.

Gully-control work in 17 Southern and Midwestern States has been approved as part of the national conservation program. It is especially suited for a Conservation Corps activity because it is largely hand labor and is of wide public benefit. Engineers of the Bureau have prepared specifications covering the engineering phases of the work. The recommendations have been standardized, as far as possible, so that the work accomplished by the Corps will be of lasting benefit and the types of work will be uniform in all States. Effort has been made to obtain work that will result in greatest economic benefit to the Nation.

Soil-saving dams of earth and masonry 6 to 25 feet high are being built to control large gullies. The larger dams are located so as to impound considerable water and help in lowering flood stages. The ponds above the dams eventually will fill with silt. Small gullies 2 to 6 feet deep are being controlled by the construction of check dams of brush, wire, poles, and rock, which catch

the rich topsoil and give vegetation a chance to become firmly established. Plantings of suitable trees, shrubs, vines, and grasses will be made to obtain permanent control when the gullies have filled with soil.

In some sections of the Great Plains, small dams of earth or masonry are built in streams where considerable water will be impounded, to serve both for flood control and water conservation.

The barrier system developed by engineers of the Bureau for control of floods in mountain streams has thus far operated so successfully in preventing damage by the waters and the debris that construction of such systems has been included in the emergency program. The bureau is cooperating in the organization of flood- and erosion-control camps in Utah, Nevada, New Mexico, Texas, and Arizona. This work has been developing rapidly and appears likely to become one of the most important of the general plans for improvement of erosion and run-off conditions in the West.

FARM-MACHINERY INVESTIGATIONS

CORN-BORER CONTROL

The principal field headquarters for the studies in control of the European corn borer in the western area of infestation are still the experimental farm near Toledo, Ohio, but the headquarters in the eastern infestation were moved during the year from South Norwalk, Conn., to Trenton, N.J.

The work on plows and plow attachments has been concentrated on the further development and testing of the loop-type trash guides to obtain coverage of crop debris. This device used with suitable colters and jointers has given better results than any attachments previously developed or tested. A public patent on this guide has now been granted. The plow equipment commonly used near Toledo leaves from 5 to 14 percent of the stalks uncovered, but one farmer who had been leaving 15 percent uncovered reduced this figure to only 0.7 percent by using the recommended equipment. By using the trash guides, colter, and jointers, excellent coverage has been obtained in the Toledo area with tractor plows even as small as 12-inch.

A study of draft of plows as affected by such factors as height of hitch, moisture content of soil, and previous crop has been continued. A device for measuring soils resistance has been constructed and tested in the field. Use of this machine in any field is expected to indicate what the draft of plows or other tools and implements will be. A device for quickly and accurately measuring the depth and width of plowing was made, particularly for use in plow-testing work of all kinds.

A corn picker was rebuilt so that the stalks would be severed at the ground surface, the corn picked, and the stalks cut into small pieces in order to kill the borers present. The processed stalks could be collected or be scattered on the field. This machine worked very well in preliminary trials and will be tested further during the 1933 harvest season. A low-cutting hand hoe was developed for use in New England, where much of the silage corn is cut by hand, and implement manufacturers have put it on the market and sold about 900 of them during the past season. Several types of low-cutting sled harvesters to be drawn by one horse were constructed.

Some improvements in commercial spraying equipment for use on growing corn were made at the eastern experiment farm, but not much spraying was attempted at Toledo because of Stewart's disease in the sweet corn there.

The European corn borer was found in Wisconsin in 1932, seeming to threaten an early infestation in Illinois from either Wisconsin or Indiana. Therefore the investigations being conducted in cooperation with the agricultural engineering department of the University of Illinois were expanded to include determination as to whether present farm practices would affect or be affected by methods necessary for corn-borer control. The work thus far has consisted of analyzing data covering the northeastern part of the State, collected by the State agricultural statistician concerning corn-harvesting methods. The data showed that approximately 49 percent of the 1932 corn crop was hand picked, 28 percent machine picked, 11 percent cut for silage, 9 percent cut for fodder, and 3 percent hogged off.

MECHANICAL DISTRIBUTION OF FERTILIZERS

The study of fertilizer-distributing machinery was undertaken to obtain fundamental information upon which could be based the design and construc-

tion of equipment for accurate distribution of the fertilizer and proper placement of it in the soil with respect to the seed or plant. Such information also aids a farmer to select, from the numerous designs on the market, the distributor best adapted to his requirements. Some results of the investigation have been used by manufacturers in improving their fertilizer distributors for cotton and potatoes. The work during the past year has been largely a continuation of field experiments previously begun, in cooperation with the Bureau of Plant Industry, the Bureau of Chemistry and Soils, the Joint Committee on Fertilizer Application, the National Fertilizer Association, and the State agricultural experiment stations. The investigation has been expanded to include lima beans with other kinds, and tobacco, and now comprises experiments with cotton at 14 locations in 8 States, potatoes at 6 locations in 5 States, beans at 8 locations in 2 States, tobacco at 4 locations in 4 States, and sugar beets [1] at 4 locations in 4 States. The progress report on mechanical application of fertilizers to cotton in South Carolina in 1931 was printed as Circular 264, Mechanical Application of Fertilizers to Cotton in South Carolina, 1931.

The studies to date indicate that rapidity and percentage of seed germination, early plant growth, and yield of crop depend to a considerable degree on the fertilizer placement. With cotton, deterrent or injurious effects resulted from placements which permitted a high concentration of fertilizer salts in the soil solution around the seed or plant. The salts in solution readily move vertically but very little laterally. With recommended applications for fertilizers at times of planting, extreme crop differences among placements usually were obtained either on sandy soils or under adverse moisture conditions. In general, the effects of differences in fertilizer placement have been similar but varying in degree, for the different crops and conditions, except with small applications and when the fertilizer was carried downward by abnormally heavy rainfall immediately after planting.

The special equipment developed by engineers for the varied requirements of the fertilizer-placement studies is continually being increased or improved. The experimental machines now include 3 for cotton, 2 for potatoes, 2 for beans, 1 for tobacco, 1 for sugar beets, and 1 side-dressing machine. Apparatus has been built for laboratory testing of both experimental and commercial distributors, and tests are being made of different types of dispensing mechanisms and placement devices, and of the resistance of different metals to corrosion by fertilizer mixtures.

SUGAR-BEET MACHINERY

Studies of machinery for the production and harvesting of sugar beets were continued at Fort Collins, Colo., and Davis, Calif., cooperatively with the Bureaus of Plant Industry and of Chemistry and Soils and the State agricultural experiment stations. Most of the machine tests were conducted on a 10-acre field obtained for that purpose near Fort Collins. The studies of labor and machine methods seem to indicate that, even with the limitations and the additional cost of this experimental work, the crop will pay a profit.

Experiments with beet planters show large differences in the stands obtained with different machines now on the market. One machine gave a stand of only 101 plants and another of 160 plants, whereas the check stand, placed by hand, was 185 plants. Some progress has been made in determining the causes of the poor showing made by some machines, and in improving those designs.

The second year's studies of fertilizer placement for sugar beets indicated that the location of the fertilizer with reference to the beet seed is of great importance. The plant growth indicates that there will be very significant differences in crop yield, with different placements. Apparently the best location for the fertilizer is under the seed. A very satisfactory plant growth generally was obtained when the fertilizer was placed with the seed, but in certain districts where the moisture was low there was a reduction of yield due to burning of the young beet plants. Because of this condition, 7,000 of 11,000 acres in the vicinity of Billings, Mont., had to be replanted in 1933.

Further studies have been made of machines for cross blocking beets. Leaflet 97, Cross Blocking Sugar Beets by Machine, has just been published. The sugar-refining companies in the Mountain States are this year recommending to their growers that they block their beets by machine. One of the companies reports that about 35 percent of the farmers in 1932 employed only their own

[1] Reported under Sugar-Beet Machinery.

family labor, using no foreign or imported labor and the indications are that about the same condition prevails in 1933. Under such circumstances mechanical blocking and other labor-saving methods are more necessary than before.

COTTON-PRODUCTION MACHINERY

The investigation as to economical use of machinery in the production of cotton, at Prattville, Ala., and West Point, Miss., were continued in cooperation with the Alabama and Mississippi Agricultural Experiment Stations, and cooperative studies were started at Stoneville, Miss.

On the Greenville fine sandy loam at Prattville, 48 combinations of methods used in seed-bed preparation were studied. The machine power required for the different methods varied from zero where only hand labor was used to 71 horsepower-hours per acre where machinery was used extensively. The hoe labor required to keep the land free of weeds varied from 7 to 62 hours. On July 1, 1933, the plant growth varied from 8 inches on the very loose soil, where little or no machine preparation was done, to 24 inches on the soil which had been well pulverized and firmed by considerable machine work.

On Houston clay at West Point, practically 50 percent more power was required for the different operations than at Prattville, and the effects of machine preparation on plant growth and crop yield appeared to be contrary to those observed at Prattville. On buckshot soil at Stoneville the total power requirements for the machine used ranged from 3 to 40 horsepower-hours per acre.

The two season's experiments in cotton-production methods indicate that the labor requirements for producing the crop up to harvest may vary from 44 to 122 man-hours per acre when only 1-mule implements are used, from 34 to 88 man-hours per acre with 2-mule implements, and from 5 to 9 man-hours per acre with tractor equipment, depending in each case upon the combination of power, labor, and equipment used.

The variable-depth planter developed last year produced, in 36 tests at Prattville, 14 percent more cotton than the highest yield with other methods of planting.

CORN-PRODUCTION MACHINERY

The investigation of economical use of labor and equipment in the production of corn has been continued in cooperation with the agricultural experiment station at Ames, Iowa. The object is to determine how costs can be reduced, consistent with obtaining good yield and quality of corn, good weed control, and advantageous soil management.

Two series of corn-picker tests were run the past season on two-row tractor, power-take-off machines. Out of 54 tests made in the past 2 years, only 3 showed field losses less than 10 percent of the yield; the majority showed losses ranging from 10 to 20 percent. During tests, three men husked and put into the crib about 100 bushels per hour, which would require 12 to 15 average workers harvesting by hand. Timeliness tests with a typical picker showed field losses increasing from 8.3 percent of yield on October 26 to 12.1 percent on January 8, and 25.4 percent on January 17. The rather extensive practice of harrowing, raking, and burning cornstalks before plowing for corn in the spring required 0.47 man-hour of labor per acre, but had no measurable advantage of any kind over single disking which required only 0.25 man-hour and was better from both mechanical and soil-management standpoints.

Labor and power requirements for drilled corn were 10 to 12 percent less than for checked corn. Yields in 1932 were a little higher with the drilled corn, and weed control was slightly better with the checked corn. The labor and power expenditure on listed corn was about 25 percent less than on drilled corn with the equipment used in these experiments, and yields were practically alike.

To make trials of promising ideas which are not embodied in any commercially manufactured machines, the following experimental equipment was built during the year: (1) A one-man wagon hitch with which one man could change wagons in 37 seconds; (2) a corn picker of new design, to gather a larger portion of the crop; (3) an attachment for a lister to make dams in the furrows at short intervals, to prevent water from washing out seed and small plants on slopes, and also to prevent accumulation of water in the furrows at low places; (4) a planter which plants the kernels in small depressions, to accomplish for surface-planted corn results like those obtained with the furrow-damming lister; (5) a cultivator which leaves depressions in the ground be-

tween corn rows to conserve rainfall and prevent erosion; (6) a rotary-weeder attachment to pull behind a disk harrow for first cultivation of corn listed with the furrow-damming lister; and (7) a check-wire cross-over to fit the 4-row tractor corn planter. Not all these devices are as yet satisfactory.

POWER AND MACHINERY ON FARMS

The reports upon utilization and cost of power on plantations in the Mississippi Delta and in Georgia and South Carolina are nearing completion, and that for the Corn Belt, Technical Bulletin 384, Utilization and Cost of Power on Corn Belt Farms, has been completed. All were prepared in cooperation with the Bureaus of Animal Industry and Agricultural Economics and the State agricultural experiment stations.

In the Delta in 1929, the average cost of power on plantations using mules where records were obtained was $8.18 per crop-acre. Where tractors were used the cost was $9.05 per acre for the conventional noncultivating tractors, $8.34 for the general-purpose tractors, and $8.23 on the plantations where both types of tractors were used.

In Georgia and South Carolina in 1929 the average costs of power on plantations using mules were $5.05 per crop-acre in the Coastal Plain area, $5.73 in the Piedmont area, and $7.23 in the Limestone Valley area per crop-acre. On plantations using tractors the average costs were, for general-purpose tractors $4.94, $6.15, and $7.24 per crop-acre for the three areas, respectively, and for noncultivating tractors $6.14, $8.02, and $8.44 per crop-acre.

SPRAYING EQUIPMENT

The studies begun last year in cooperation with the Bureaus of Entomology and Plant Industry at Albany, Ga., on spraying equipment for controlling insect pests and diseases in pecan orchards, were continued. Tests to determine rates of discharge and distribution of spray were made on several of the guns most commonly used for pecan spraying, at pressures of 200 to 500 pounds per square inch with disk apertures of one eighth to one fourth inch. The larger guns discharged as much as 20.4 gallons per minute at 300 pounds pressure, with the ¼-inch disk aperture.

PINK-BOLLWORM CONTROL

Further tests of measures for controlling the pink bollworm were made during the year at Presidio, Tex., in cooperation with the Bureau of Entomology and the Texas Agricultural Experiment Station. These tests included plowing and irrigation, and the removal of unpicked cotton bolls and of plants from infested fields.

The infestation of green bolls indicates that the plowing in January followed by immediate irrigation was more effective than either early plowing with late irrigation or late plowing with immediate irrigation. The 14-inch moldboard plow was more effective than the tractor-disk plow in combating the worm. These findings support the results of tests in former years on very small plots.

With 36-inch rows, stalks were cut at the rate of 1¾ acres per hour. A single-row chain-type cotton stripper was used for removing unpicked bolls in a heavily infested field, to study the effectiveness of this operation for decreasing the winter carry-over of pink boll worms. No tests were made before the first killing frost. In cotton 2½ to 3 feet high 89 to 92 percent of the unpicked or undeveloped bolls were collected by the machine and were readily burnable. Where the plants were 3 to 6 feet high and of rank growth, the tops of many were broken off and carried back into the cotton-receiving box, and there was frequent choking of the gatherer chains. Because of difficulty in using the ordinary horse-drawn cornstalk shaver for cutting cotton stalks preparatory to raking, a push-type shaver attached to the front axle of a tractor was developed. Preliminary tests gave very satisfactory results, especially where the stalks were large.

ARTIFICIAL DRYING OF CROPS

In an effort to cut down the cost of dehydrating forage, the experiments at Jeanerette, La., in cooperation with the Bureaus of Animal Industry, Dairy Industry, and Plant Industry, have included crushing of the forage both in

the field and at the drier. Crushing the plants makes them more easily dried. Crushing is especially helpful when the forage contains large-stemmed plants that, uncrushed, would be very slow to give up their moisture. Crushing the material at the drier instead of in the field increased the output of the drier about 10 percent, but this apparent saving was fully offset by the additional power required for crushing. Evaporation of water from crushed forage exposed to sun and wind was found to be 50 percent greater than that from uncrushed forage similarly exposed. This additional wilting reduced the cost of crushing, handling, and drying by one fourth. However, where the growth is heavy and the plants are of a viny nature, as with soybeans sown broadcast, considerable difficulty was experienced in operating the mowing and crushing machine. An experimental forage crusher was built in which the rolls were heated to temperatures ranging from 450° to 750° F. This crusher reduced the moisture content of the material 5 percent and made the material easier to dry in the apron-conveyor drier.

SEED CLEANERS AND SCARIFIERS

A study to develop a suitable machine or method for removing smut balls from seed wheat with commercially available farm equipment has been begun in cooperation with the Bureaus of Plant Industry and Agricultural Economics. In tests of farm-size seed cleaners operated in the usual manner 15 to 95 percent of the smut balls were removed, and experiments indicate that 100-percent removal may be possible with a common type of cleaner properly adjusted and operated.

To develop a method of hulling or scarifying seed in small lots with equipment available or easily obtained on the farm, studies are being made in cooperation with the Bureau of Plant Industry. Tests with sweet clover, lespedeza, and crotalaria seed indicate that such may be hulled or scarified satisfactorily with gravel in a farm-size concrete mixer. For hulling or scarifying on a larger scale an experimental machine has been constructed, in which the seeds pass between two disks, the lower covered with an abrasive and the upper with rubber.

JAPANESE-BEETLE CONTROL

In cooperation with the Bureau of Entomology, a series of field tests were made in the spring of 1933 to determine the effectiveness of various types of rotary plows and rototillers in combating the Japanese-beetle grub. It was found that the machine which produced the greatest milling action effected the highest kill. Alterations are being made on a rotary cultivator in order to obtain a higher mortality than that indicated in the tests.

ALCOHOL-GASOLINE FUEL TESTS

Because of the considerable agitation for using alcohol-gasoline blends in automotive equipment, the Bureau of Agricultural Engineering conducted a number of field and laboratory tests on tractors and trucks to compare performance characteristics of these blends with those of plain gasoline. The laboratory tests were conducted at the Naval Engineering Experiment Station at Annapolis, Md., and the field tests were made at the Bureau's station at Toledo, Ohio.

Preliminary experiments indicated that absolute alcohol could be mixed with gasoline in practically any proportion. Octane ratings of three plain gasolines averaged 66.6, and of mixtures containing 10, 20, and 30 percent absolute alcohol averaged 74.0, 79.6, and 84.6, respectively. Tests on an engine designed for adjusting the compression ratio gave, running at 1,200 revolutions per minute, a highest useful compression ratio of 5.6 and a maximum horsepower of 24.6 when using plain gasoline; a highest useful compression ratio of 6.1 and maximum horsepower of 26.0 for the 10-percent blend; and a highest useful compression ratio of 6.5 and maximum horsepower of 27.2 for the 20-percent blend.

Road tests with trucks over a 20-mile course on paved highways did not show any significant differences in fuel consumption between plain gasoline and the 10-percent blend. Performance tests in routine work are being conducted with two one-half-ton trucks of the same make and model, one using plain gasoline and the other a 10-percent alcohol blend. At approximately 2,000 miles of travel the former had averaged 15.6 and the latter 14.6 miles per gallon, and there was considerably more carbon in the head of the engine burning plain gasoline.

In belt tests with a standard four-cylinder tractor the maximum horsepower developed was 31.8 on plain gasoline and 31.6 on the 10-percent blend, and there was very little difference in quantity of fuel used. In plowing also this tractor used about the same quantity of either kind of fuel. Belt tests of a tractor fitted with high-altitude pistons developed, without severe detonation, a maximum of 30 horsepower with plain gasoline, which with the addition of alcohol increased to 44.4 horsepower with a 30-percent blend. Only with the 20-percent blend was fuel economy better than with plain gasoline. In a two-cylinder horizontal tractor engine tested on the belt and in plowing, using plain gasoline and the 10-percent blend, the tractor showed little difference in quantity of fuel used or maximum horsepower output.

COTTON-GINNING INVESTIGATIONS

At the cotton-ginning laboratory at Stoneville, Miss., some 6,000 lint samples were ginned of approximately 100 different combinations of conditioning, cleaning, and ginning machinery operated at different speeds and with loose and tight seed rolls, from 64 separate lots of freshly picked seed cotton from South Carolina, Georgia, Alabama, Mississippi, Tennessee, Arkansas, Louisiana, and Texas. The studies have been carried on, as before, in cooperation with the Bureau of Agricultural Economics and the State agricultural experiment station at Stoneville.

The results emphasized the findings of former years, that the moisture content of seed cotton delivered for ginning has considerable effect on the operation of the cleaning and ginning machinery and on the quality of ginned lint. While the fiber analyses for the 1932 crop have not been completed, it seems very evident that gin-saw speeds are of less importance in determining the quality of the gin output than either the seed-roll density or the moisture content of the seed cotton. The loose seed roll gave better results than the tight seed roll under nearly all conditions.

Other combinations of cleaning machinery were tested in addition to those used in prior seasons, and further evidence was obtained that the excessive use of cleaning machinery injuriously affects the quality of the lint ginned from the long-staple varieties of cotton. It was found also that only simple combinations of machinery are required to handle the hand-picked short-staple cottons, and that the more complex equipment necessary for sledded and machine-stripped cottons did not improve the quality of the lint to equal that from the hand-picked cotton.

Further improvements were made in the vertical seed-cotton drier, by inserting special screening devices which obtain the removal of an important amount of pin trash in the final stages of drying the seed cotton. Several large manufacturers of cotton-ginning machinery have, with the assistance of engineers at the Stoneville laboratory, adapted the Government process of drying seed cotton to new designs of their own machinery and have placed those designs upon the market. It is estimated that during the ginning season of 1932–33, in the long-staple cotton districts of the Mississippi River Valley, at least 45,000 bales of cotton were handled by vertical seed-cotton driers of the type developed by this Bureau.

In the Salt River Valley at Arizona, in cooperation with the Bureaus of Agricultural Economics and Plant Industry, preliminary tests were made with roller gins with a view to improving methods of cleaning and ginning the Pima cottons. It was possible to improve the metal doffer brought out by the Bureau of Plant Industry in 1926, but the brush doffing attachment recently developed by the Bureau of Agricultural Engineering apparently produces a smoother sample at certain speeds. Efforts to gin Pima cotton with saw gins did not obtain satisfactory results.

FARM-STRUCTURES INVESTIGATIONS

IMPROVEMENT OF FARM HOMES

Brief surveys of farmhouse conditions and needs were made in Michigan, Ohio, North Carolina, South Carolina, Georgia, and Alabama in cooperation with representatives of the State agricultural experiment stations and extension workers. Improvement in rural housing is proceeding slowly at present in the sections observed and consists largely of maintenance work, minor rearrangement, and the installation of labor-saving equipment. New farm-

houses being erected number perhaps 10 percent of normal and are largely to replace losses by fire and storm.

The development of good types of farmhouses and the building of them have progressed slowly because farmers and others concerned have not fully recognized the differences in requirements of farm and city homes and often have copied town houses without considering the work that must be done in the farmhouse and how the house is related to the other buildings. However, some very good work is being done by farm people in cooperation with the State extension workers in the remodeling of old homes which years of use have proved to be needlessly inconvenient. Remodeling usually starts with the kitchen, and many awkward, badly lighted kitchens have been changed into pleasant, convenient workrooms at small expense.

The low rate of building during the past several years suggests that when farmers have money available there will be a large amount of new building to replace old houses that have passed their usefulness. If 100,000 new farmhouses were erected each year it would take more than 60 years to replace those now in use. The Bureau is developing plans for farmhouses designed to embody the specifications for efficient arrangement, convenient equipment, and family comfort recommended by the President's Conference on Home Building and Home Ownership (1931), as applied to typical conditions of location, size of farm, and type of farming. A comprehensive study of the modern vaporizing type of domestic oil burner as applied to house heating, water heating, and cooking, has been undertaken. Farmers' Bulletin 1698, Heating the Farm Home was issued during the past year, and Farmers' Bulletin 1426, Farm Plumbing, was revised and brought up to date.

FARM-BUILDING CONSTRUCTION

An experimental building with walls of rammed earth (pisé de terre) was erected on the Arlington Experiment Farm, Va. The earth for the walls was clay loam subsoil, excavated in digging the cellar of a nearby building, and the walls were built by tamping the moist earth into movable wooden forms. Walls of this type have been used in Europe for many years, and there are a considerable number of examples of such construction in this country, some built as early at 1821 and still in good condition. An earthen wall has good heat insulating properties and makes a very comfortable building. A test section of wall, 10 inches thick, 7 feet high, and 8 feet long at the Arlington farm supported 60,000 pounds without failing; after part of this wall had been torn away, reducing its length to 5 feet 4 inches, it failed under a load of 48,000 pounds. The cost of a 12-inch wall, with all laborers paid at least 50 cents per hour, was somewhat higher than for a 6-inch concrete wall, because of the large amount of work required to tamp the earth into the forms. However, this type of construction has advantages where labor is cheap as compared with the cost of material, and where suitable earth is available.

Rammed earth walls must be waterproofed, and some 40 types of exterior finishes are being tried on this wall. To date, tar and asphalt coatings have given the most satisfactory results except in appearance, in which respect they may be improved by painting with aluminum paint. Linseed-oil paints are better in appearance than tar and asphalt, but apparently do not protect the wall so well. Both lime and cement stucco on these walls developed cracks, which perhaps could have been avoided if steel reinforcement had been used in the stucco.

Experiments were made with canvas applied over wood sheathing as a covering for small buildings, in place of wood siding. When canvas is used as a wall covering no trim is needed around doors and windows, and it presents a smooth surface which is in keeping with modern trends in building. Various kinds of paint are being tried with the canvas coverings, but sufficient time has not elapsed to determine which are most satisfactory.

Leaflet 87, Wind-resistant Construction for Farm Buildings, and Circular 254, Greenhouse Heating, were issued during the year. The latter presents a detailed discussion of the characteristics and requirements of greenhouse heating systems and design data for such systems.

Pressures on the walls, floor, and cross bracing of corncribs were measured in an experimental corncrib 8 feet wide, 16 feet long, and 24 feet high. When the crib was equipped with cross bracing such as is commonly used in frame-construction cribs, and filled to a height of 24 feet, cross braces 6 feet apart supported about 35 percent of the total weight of the corn, 20 percent addi-

tional was supported by the friction of the corn on the walls, and only 45 percent of the total weight was carried by the floor. The maximum outward pressure occurred at the bottom of the crib and amounted to about 90 to 100 pounds per square foot when the crib was full and the cross bracing was in place. When no cross bracing was used the outward pressure at the bottom of the crib was 100 to 110 pounds per square foot. Farmers' Bulletin 1701, Corncribs for the Corn Belt, was issued giving information on the design, construction, and equipment of modern corncribs and combined corncribs and granaries.

STEAM FOR SOIL STERILIZATION

The experiments in use of steam for sterilizing greenhouse soil were completed. They were carried on at the Naval Engineering Experiment Station at Annapolis, Md., because of the facilities there for obtaining steam in ample quantities at a wide range of pressures and temperatures. Experiments were made with surface-pan heaters about 7 feet square and with subsurface steam lines of 4-inch clay draintile, 18 inches deep and 18 inches apart. Soil of texture like that in greenhouses was made by mixing clay loam, sandy loam, and stable manure.

Soil temperatures of 212° F. were obtained with steam at all pressures between 2 and 85 pounds per square inch at point of delivery to the sterilizing pan or the tile, and the moisture content of the soil after sterilization was practically the same in all cases. It was impracticable to maintain pressures of more than a few ounces either in the pans or in the tile. Higher temperatures in the soil beds could be obtained only by using superheated steam and increasing the time of application, which materially increased the expense. In all tests with ordinary steam, the time required to secure temperatures of 212° depended on the quantity of steam supplied and was little affected by the pressure. Evidently there is little advantage in high-pressure steam for sterilizing greenhouse beds. High pressure of course increases the amount of steam that can be forced through pipes of a given size, but the boilers necessary are of a more expensive type and require more careful attention than those for generating steam at pressures of 15 pounds per square inch or less.

STORAGE AND TRANSPORTATION OF PERISHABLE PRODUCTS

As a result of the experiments at Presque Isle, Maine, in cooperation with the Bureau of Plant Industry and the State Agricultural Experiment Station, several practices were developed which aid in reducing losses and improving the quality of potatoes delivered to the consumer. Sprouting and rotting were reduced and edibility improved by better control of ventilation, through use of insulated ventilating flues and air intakes which may be easily operated. Bruising was materially reduced by warming the potatoes to about 50° F., before passing them over the grader, and by using graders and methods which avoid dropping the potatoes during handling. Simple means for accomplishing these purposes were devised.

Use of wet shavings on the floor of the refrigerator car as a means of protecting fruit shipments in cold weather gave promising results. The protection is furnished by the latent heat of freezing of the water in the shavings. The method seems particularly adapted to shipments of pears, which can stand a certain amount of freezing with very little damage but are particularly sensitive to the higher temperatures resulting from other methods of protection. This work was done in cooperation with the Bureau of Plant Industry.

During the year a very sensitive calorimeter was constructed for measuring the heat of respiration of fruits and vegetables. No such measurements have been reported in the United States, and it is hoped that knowledge of the amount of heat generated by fruits and vegetables during the storage and shipping periods will be of benefit, particularly to the fruit industries and to concerns which store and refrigerate large quantities of fruit.

EXTENSION WORK

The extension activities of the Bureau of Agricultural Engineering are conducted cooperatively with the Office of Cooperative Extension Work of the Department and the State extension offices. This engineering extension work makes available the conclusions from the researches of the Bureau, in the form of recommendations for farm practices correlated with recommendations from other sources within the various States and aids extension workers in

developing methods for acquainting farmers with the improved practices recommended. Agricultural engineering-extension recommendations not only enable farmers to conserve the fertility of fields and utilize the rainfall, labor, power, and equipment available to the best advantage for low-cost production of high-quality farm commodities but also contribute a service directed toward making farm life less arduous and more attractive. Agricultural engineering-extension work relates to four types of activities, as follows:

1. Improvement of fields by means of terracing, drainage, irrigation, and clearing of stumps and stones, and conservation of soil and moisture on other lands.
2. Utilization of labor, power, and equipment for the production of high-quality commodities at low cost.
3. Building-plan service to provide alteration and construction recommendations in conformity with the storing, housing, and dwelling recommendations of the Department and of the extension services of the States.
4. Farm and home utility plans and engineering specifications in cooperation with home economics projects to enrich farm-home life.

During the past year, in harmony with the economic situation on farms, the engineering recommendations have emphasized conservation and improvement of natural farm resources, efficient production with low cash expenditures, quality production and conservation for marketing advantage, a change in the utilization of labor from production of surplus cash crops to production of fertility crops and of food and feed crops for home consumption, the utilization of more labor for farm and home improvement, and the installation of utilities and conveniences.

For 30 years engineers of the Department have studied improved methods of controlling erosion on farm land by means of terracing and gully-reclaiming checks and dams. For 15 years the Extension Service has made the recommendations available to farmers through demonstrations of the practices outlined in a series of 6 Department bulletins and 15 State bulletins based on engineering research in the Department of Agriculture. During the last 10 years nearly 13,000,000 acres on 400,000 farms have been terraced in conformity with these recommendations. In the past year, in spite of financial difficulties on farms, nearly 1,500,000 acres were terraced on over 44,000 farms under extension supervision, and the interest in soil-conservation practices has been very much stimulated by important research information recently released by the Bureau of Agricultural Engineering.

The work relating to power and machinery has been very timely, furnishing to farmers through demonstrations information on the repair and adjustment of farm machinery and recommendations for obtaining a balance between field acreage, labor, and equipment for economic production. Extension workers reported more than 40,000 machines repaired last year in demonstrations, and nearly 29,000 farms employing better machinery practices by following extension engineering recommendations. Building recommendations have reflected emergency conditions again during the past year. Hundreds of trench silos have been built in many States. Repairing and remodeling has been necessary on a wide scale. More stringent enforcement of milk ordinances has been a burden to many dairymen, but the Extension Service has minimized the expense of the building changes required by furnishing plans of low-cost construction approved by the health officers. The Bureau also furnished film-strip lectures for extension workers this year on the construction of dwellings with a variety of low-cost but attractive building materials, and cooperated in the production of a film-strip lecture on fire prevention. Extension workers reported construction of buildings in conformity with plans embodying extension recommendations on over 50,000 farms last year, while the number of home and farm utility improvements reported was nearly 14,000.

Through the Office of Cooperative Extension Work, the Bureau of Agricultural Engineering and State agricultural engineers effected improvements in equipment or practices on more than 150,000 farms during the past year, exclusive of the changes effected by the direct contacts of the Bureau through its staff and publications.

SERVICE WORK

The engineering service rendered to other bureaus and other departments has been somewhat less during the past year than in that preceding, at least partly because the economy program curtailed funds for new building and equipment

of all kinds. The work done included preparation of plans and specifications for structures and equipment, also some inspection of construction, and some special studies and reports, the major items being as follows:

For the Bureau of Animal Industry, a laboratory building on the experiment farm at Beltsville, Md.; water and electric systems, refrigeration, and other physical improvements for field stations at Brooksville, Fla., Jeanerette, La., and Beltsville, Md.

For the Bureau of Biological Survey, a final report on design and construction of the Bear River Migratory Bird Refuge in Utah.

For the Bureau of Chemistry and Soils, two residences on Naval Stores Station at Lake City, Fla.

For the Bureau of Dairy Industry, laboratory equipment in the South Building, Washington, D.C.

For the Bureau of Entomology, a head house on the Arlington Experiment Farm at Rosslyn, Va.

For the Extension Service, exhibit material for the Century of Progress Exposition at Chicago, Ill.

For the Food and Drug Administration, a greenhouse at Haddon Heights, N.J.; laboratory equipment in the South Building, Washington, D.C.

For the Bureau of Home Economics, typical layouts of canning centers.

For the Bureau of Plant Industry, a cereal greenhouse and installations of drains, sewers, and ventilating and electrical equipment on the Arlington Experiment Farm, Va.

For the Bureau of Plant Quarantine, laboratory equipment.

For the Department of the Interior, an investigation and report upon the amount and possible use of waste water from the Newlands reclamation project, Nevada.

For the International Joint Commission, in cooperation with the United States Geological Survey, a continuation of the investigation for determining probable damages to agricultural lands in Kootenai River in Idaho from construction of a proposed power development near Nelson, British Columbia.

For the Mississippi River Commission, in cooperation with the Forest Service and the Bureaus of Agricultural Economics and of Chemistry and Soils, completion of an appraisal of flowage damages which will accrue to agricultural lands in the Birds Point-New Madrid floodway.

For the War Department, in cooperation with the Bureaus of Agricultural Economics and of Chemistry and Soils, an appraisal of certain lands along the Illinois River which will be affected by construction of the Illinois waterway improvements.

U.S. GOVERNMENT PRINTING OFFICE: 1933

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REPORT OF THE CHIEF OF THE BUREAU OF ANIMAL INDUSTRY, 1933

United States Department of Agriculture,
Bureau of Animal Industry,
Washington, D.C., August 31, 1933.

Sir: I present herewith the report of the Bureau of Animal Industry for the fiscal year ended June 30, 1933.

J. R. Mohler, *Chief.*

Hon. Henry A. Wallace,
Secretary of Agriculture.

BUREAU ACTIVITIES AS RELATED TO CONTROLLED AGRICULTURE

The year covered by this report was marked by continued progress in improved methods of livestock production and in bringing animal diseases under control. These activities are noteworthy in view of recent national legislation and the Department's current efforts for a more fully controlled agriculture. In such a program expert knowledge concerning breeding, feeding, management, and disease control is more important than ever. It is readily apparent that lack of control over any of these prime factors would introduce serious risks likely to nullify other efforts and greatly influence the final result. Fortunately, past regulatory work and research have eliminated or greatly reduced serious risks and have provided technical knowledge needed in planning effective agricultural adjustment.

ANIMAL-HUSBANDRY INVESTIGATIONS

During the year the Bureau continued its fundamental research and cooperated with State research and extension agencies in a Nation-wide effort to aid farmers in adapting their operations to present conditions. The production of greater proportions of foods and feed supplies at home received particular emphasis.

In the home curing of meat the Bureau has assisted farmers in improving the quality of the products and preventing losses through spoilage and deterioration. Home butchering of hogs in Texas has increased about 50 percent in the last 2 years; at present it is practiced on about 75 percent of the farms in the State. Georgia farmers now cure about 15,000,000 pounds of pork annually under refrigeration, much of it in their cooperative storage plants.

The meat program has not only aided producers in developing a more effective live-at-home program, but has furnished an incentive to use, for forage and feed, much of the acreage taken out of surplus crops.

Grazing investigations have shown that although livestock do not produce so much from an acre of pasture as from an acre of harvested crops, the cost of feed from pasture is usually less and the return more than from harvested feeds. Experiments have shown also the high nutritive value of pasturage and the acceptable quality of meat produced wholly from grass or from a combination of grain and grass. Therefore, a much more extensive use of grass in the national program of livestock production seems desirable.

In meat investigations, a summary of 10 experiments conducted for several years in cooperation with the Louisiana, Virginia, and West Virginia stations showed that beef from cattle finished on good pasture is nearly as palatable as that from cattle fed grain in addition to grass. The investigations indicate also that the cause of market discrimination against grass-fed cattle is largely a lack of sufficient finish.

Studies on the inheritance of egg production in poultry have shown that the average production of a sire's daughters is the most reliable index of his breed-

ing potentiality. This knowledge has wide practical application in the improvement of poultry flocks with respect to egg yields.

PROGRESS IN ERADICATING TUBERCULOSIS

Among the Bureau's activities in eradicating, controlling, and preventing animal maladies, the cooperative campaign to eradicate tuberculosis is noteworthy. As the result of extensive tuberculin testing, which included more than 13,000,000 cattle, excellent progress was made in increasing the extent of modified accredited areas. This term signifies the reduction of bovine tuberculosis to one half of 1 percent, or less, of all the cattle, through official tuberculin testing supplemented by the removal of reactors. Three more States—Nevada, New Hampshire, and Utah—were added to those previously recognized as modified accredited areas, making a total of 11 States in this designation at the close of the fiscal year.

TICK ERADICATION

The campaign to eradicate the cattle tick, which carries southern or tick fever, continued to be effective. As a result of systematic dipping of cattle, horses, and mules in tick-infested areas, an aggregate area of 20,290 square miles was released from Federal quarantine during the year. This territory consisted of 7 counties and part of 1 county in Arkansas, thereby freeing the entire State; 6 counties and parts of 3 counties in Florida; and 10 counties and part of 1 county in Texas. Federal quarantine against cattle ticks is now limited to parts of only 3 States, Louisiana, Florida, and Texas.

ANIMAL-DISEASE INVESTIGATIONS

The search for improved means of combating infectious abortion has been continued, both through independent efforts and in cooperation with eight universities and experiment stations. Additional evidence indicates that the skin is probably a channel of importance through which cattle become infected with *Brucella abortus*. Efforts to isolate *Br. abortus* from six pregnant cows intensely exposed, for a prolonged period, to infected swine under conditions that transmitted disease to other swine, failed. However, temporary infection in two of the cows was indicated by agglutination reactions. Experiments in vaccination, using *Br. abortus* of low virulence and vaccinating during calfhood, have yielded further evidence to justify the belief that vaccination can be made a safe and effective aid in reducing losses from abortion.

Recent investigations on swine erysipelas resulted in a serological test, by which this disease can be positively diagnosed. This method, known as the rapid, whole-blood agglutination test, should prove a great aid to veterinarians in differential diagnosis because of its reliability when used on farms as well as in the laboratory.

An outbreak of an atypical, communicable disease of unusual character occurred on March 21, 1933, in a herd of garbage-fed swine on a ranch near San Diego, Calif. Though it was not possible promptly to make a definite diagnosis, the malady gave indications of having such grave possibilities as to warrant the immediate destruction of the infected and exposed herds, four in number and consisting of 5,533 swine. The destruction of the animals was accomplished by April 8 and was immediately followed by a thorough cleaning and disinfection of the premises, in all of which county, State, Bureau, and local veterinarians, as as well as local organizations, cooperated. In the meantime, inspections were made of all domestic animals within a radius of several miles of the infected area but no further cases of the disease developed.

Animal inoculations were begun immediately on the discovery of the outbreak but the results of the earlier tests, conducted on the infected premises, were so inconclusive that further studies, under laboratory conditions and making use of a number of species of animals, were undertaken in an effort positively to identify the disease. Although these studies have not been concluded, some interesting features have been developed which will be valuable in handling similar outbreaks, should they occur.

ANIMAL-PARASITE INVESTIGATIONS

Progress was made in determining the nature of the injuries produced by animal parasites and in developing treatments and control measures. A promising method of preventing infestation of swine with kidney worms was tested in Georgia with satisfactory results. This work has shown that losses caused by kidney

worms can be practically eliminated by following simple procedures designed to prevent infestation.

Practical information on the proper time to treat horses for the removal of bots has been ascertained and distributed in connection with State-wide campaigns against these pest. Satisfactory treatments have been devised for the removal of stomach worms of swine and for the destruction of heart worms of dogs.

STOCKYARDS AND COMMISSION RATES

Under the provisions of the Packers and Stockyards Act, the Bureau continued to investigate the reasonableness of stockyards' charges and commission rates in the buying and selling of livestock. As a consequence of these investigations and subsequent orders issued by the Secretary of Agriculture, substantial reductions in rates have been made at a number of markets. It is estimated that the lower schedules of charges and commissions will save shippers who patronize those markets fully $2,000,000 a year as compared with rates in effect a few years ago.

PERSONNEL

At the beginning of the fiscal year the Bureau rolls showed 4,746 employees of all grades and designations in Washington, D.C., and in the field. During the fiscal year, 361 were added to the rolls, 320 by appointment or reappointment, 37 by transfer from other bureaus or departments, and 4 by reinstatement. During the same period 25 employees resigned, 34 died, 13 were transferred to other bureaus or departments, 165 were retired under the amended Retirement Act of May 29, 1930, and 2 were removed for cause. Other separations, principally of agents, unskilled laborers, and seasonal and temporary employees, numbered 461, making the total separations for the fiscal year, 700. On June 30, 1933, the Bureau rolls carried 4,407 employees, a net reduction during the year of 339.

VETERINARY EDUCATION

During the year 247 students graduated from the accredited veterinary colleges, a decrease of 5 compared with the preceding year. The total enrollment was 1,419 students, a slight increase over the 1,383 enrolled during the preceding year.

The number of accredited veterinary colleges in the United States remained at 11, and there are still 12 foreign recognized veterinary institutions.

PUBLICATIONS, RADIO, AND EXHIBITS

Publications prepared by the Bureau and printed by the Government during the year included 63 new and revised documents. Most of these dealt with the production and care of livestock; others were of regulatory or administrative character. In addition, Bureau employees contributed 172 manuscripts on various phases of livestock work and research to periodicals published outside the Department. As in former years, the Bureau furnished the Press Service of the Department with numerous articles on activities of public interest.

Bureau employees participated in 32 radio broadcasts over extensive networks as well as making other radio addresses of less scope.

In cooperation with the Department's Office of Exhibits, the Bureau furnished subject matter for the preparation of 9 new exhibits and the revision of 5 others. Two of the new exhibits were of extensive character, one being for the Century of Progress Exposition and the other for the International Livestock Exposition in Chicago. In addition the Bureau built 2 new exhibits and revised 3 others, besides preparing numerous charts, maps, lantern slides, and other pictorial material for which there is an extensive demand.

The work of the various divisions of the Bureau is presented more fully in the following pages.

ANIMAL HUSBANDRY DIVISION

The work of the Animal Husbandry Division, consisting chiefly of research in animal husbandry, including poultry husbandry, was conducted under the direction of E. W. Sheets, chief.

ANIMAL GENETICS

A study of the effects of age, at first breeding, upon fertility of the dam and vigor of the offspring, in which an inbred strain of guinea pigs was used, has shown that females which are not bred until they have reached a mature weight are far less productive than females which are bred when young. The chief

factors producing this result are increased sterility and a shorter reproductive period. Female guinea pigs, 33 days of age when placed with the males, showed 14 percent of sterility, whereas those not placed with males until past 1 year of age showed 45 percent of sterility. When only those matings which produced young are considered, the late-bred females produced larger litters, weaned heavier young, and had litters as frequently as females bred young. Growth was somewhat slower in the offspring of females bred young but eventually the same mature weight was reached.

Cooperative investigations with the Vanderbilt University School of Medicine have produced new information on the relation of inbreeding to the cellular characteristics of the endocrine glands, particularly the pituitary. Preliminary results obtained in studies on tissues from the Bureau's inbred strains of guinea pigs have revealed the existence of characteristic differences in the endocrine systems of different strains.

In inbreeding investigations with swine, results have been summarized on a Chester White strain which has been inbred by brother-sister matings for 6 consecutive generations, and on a Tamworth strain which has been inbred for 5 generations. In the Chester White experiment outbred sows averaged 2.4 more pigs per litter at birth, which is 34 percent more pigs than were farrowed by the inbred group. The average percentage weaned at 70 days of age was 73.2 for the inbred and 66.0 for the outbred group; however, the outbred group had a lower mortality from birth to maturity. The average litter weight at 70 days of age was 158.6 pounds in the former and 209.1 pounds in the latter group. In the Tamworth inbred group, which was much more severely affected by inbreeding than the Chester White line, the average litter weight at 70 days was only 88.6 pounds.

In spite of such low averages for both inbred strains, however, there were obtained some exceptionally good litters particularly in the Chester White strain, in which one fourth-generation litter weighed 480 pounds at 70 days. In general, the inbred stock consumed more feed per 100 pounds' gain than the outbreds. There was noticeable uniformity in type and in carcass quality among the inbreds but this advantage was scarcely sufficient to counteract, from the standpoint of practical hog production, the disadvantages of fewer pigs in litters, higher mortality, slower gain, and greater feed consumption. The results indicate that the lines which have been "purified" by inbreeding must be perpetuated by a close line-breeding system in which the effects of close inbreeding can be lessened, particularly in the female line.

ANIMAL NUTRITION

Work has been continued on the effect of diet on the composition and hatchability of eggs. Previous work had shown that the amount of vitamin B varied with the vitamin B content of the diet but that vitamin G remained relatively constant. This year when feeds unusually rich in vitamin G were fed, the eggs contained an increased amount of vitamin G. The vitamin E content of eggs was also found to be influenced by the vitamin E content of the feed. It was furthermore found that vitamin E is a factor in the hatchability of eggs.

Hogs fed restricted levels of rations containing wheat or corn not only showed a more efficient utilization of the feed, on the basis of feed per unit of gain, but their carcasses, at 200 pounds live weight, contained a higher proportion of lean cuts, having a lower fat content. The meat was as palatable as that of full-fed hogs.

The vitamin A, B, C, D, and G content of the milk of Saanen and Toggenburg goats has been determined in tests extending over a 3-year period. Whole milk, fed at a daily level of 0.5 to 1.0 cubic centimeters, supplied 1 vitamin A unit. Butterfat prepared from milk produced by the goats in March and June possessed at least 25 vitamin A units per gram. The vitamin B and G contents of winter and summer milks were similar. Considerable variation was noted in the vitamin C content. Goats' milk was found to yield a soft curd. Heating, as with cows' milk, gave a lower curd tension.

Analyses of the separate parts of plants infested by corn borers show that the leaf, stalk, grain, cob, and husk were not markedly changed in composition. Reduced production in corn-borer-infested areas, therefore, can be measured chiefly on the basis of reduced yield.

EXTENSION ACTIVITIES

Extension work in animal husbandry, including poultry and meats, was continued through agreement with the Extension Service and the State agricultural colleges. Emphasis was given to increasing net income through the production

at home of a greater proportion of food and feed supplies, and better adaptation of livestock to market requirements. Predominating activities were meat demonstrations, swine sanitation, the creep-feeding of calves, utilization of pasture and forage crops, lamb and wool improvement, and the use of modern hitches in working horses and mules.

The meat-demonstration program is carried on in 45 States. In Georgia, a cold-storage plant, owned and operated by farmers, handles a substantial part of the 15,000,000 pounds of pork cured by farmers under refrigeration in that State. The 400,000 pounds of pork handled a year ago in Louisiana under the meat-demonstration program increased more than 2,000,000 pounds this year. As a result of this work, Mississippi now has 15 communities where farmers may purchase cold storage for meat and other products. Methods for curing lamb and mutton have proved to be popular in Oregon, Washington, California, and Montana, providing additional outlets for these meats. Surplus dairy stock in New England is being canned and cured for home use.

In poultry extension work there was activity in making equipment at home and remodeling to modernize old poultry buildings. The use of a cheap type of brick brooder which helped greatly in rearing young stock was inaugurated in the South. An inexpensive brooder made of an underground trench with a tent cover was found to be very satisfactory in the Southwest.

MEAT INVESTIGATIONS

Meat investigations were continued in cooperation with the Bureaus of Agricultural Economics and Home Economics and 11 State experiment stations.

Studies on the effects of grass, in the ration, on meat quality point strongly to the possibility of lessening production costs and utilizing idle acres by the development of better pastures and their wider use in the fattening ration. A summary of 10 experiments conducted for several years in cooperation with the Louisiana, Virginia, and West Virginia experiment stations shows that beef from 2- and 3-year-old cattle fattened on good pasture alone was very similar in palatability to beef from cattle fed grain while on grass. The grain-fed cattle had a higher dressing percentage and were somewhat fatter. The results indicate that grass as a feed does not necessarily produce an inferior quality of beef, but that lack of finish or gain due to poor or insufficient pasture is often the cause of low quality that is frequently attributed to grass-finished beef.

Performance studies were continued with beef and dual-purpose cattle and with swine. Wide variations occurred among the two groups of cattle with respect to dressing percentage, carcass grade, and tenderness of the roasted meat; and among the litters of hogs with respect to dressing percentage and yields of cuts. The results were further evidence of the great importance of differences in breeding and of the opportunity which exists for effective selections of breeding animals based on tests of their progeny.

A supplement of cottonseed meal in the corn ration, when fed to hogs previously softened on a peanut ration, produced pork of satisfactory firmness. Thirteen percent of cottonseed meal in the ration appeared to be as effective as from 20 to 25 percent. Previous work had shown a hardening ration of tankage and corn to be unsatisfactory for this purpose. This work was done in cooperation with the North Carolina and Virginia experiment stations.

The average of five measurements of thickness of back fat was found to be a good index of the percentage of fat in the edible portion of hog carcasses.

In a study involving 2,073 cattle, there was close agreement between slaughter-cattle grade and beef-carcass grade. Similar results were obtained in grading 924 lambs and their carcasses. The experimental data are evidence that the different grades of beef and lamb can be recognized in the live animals with dependable accuracy.

The weights of the pituitary, thyroid, and adrenal glands from 53 barrows and 36 gilts, each animal weighing approximately 225 pounds and fattened on the same feeds, showed little relationship to rate of gain, thickness of back fat, or dressing percentage. It appeared that gland activity was not closely associated with gland weight. There were closer relationships of the weights of heart, liver, spleen, and kidneys to one another. These organs showed negative correlations with dressing percentage. However, back-fat thickness was directly related to dressing percentage.

A detailed study of temperature and of curing and storage methods in relation to the palatability of meat was begun during the year. A study of the time required to cure various lamb cuts indicated that the rather common method involving 4 days per pound for pickling pork does not apply to cuts of lamb,

which are lighter in weight. With a 50° to 60° sweet pickle, 14 days proved to be the most satisfactory for average-weight loins, racks, and breasts. Thirty days were required for legs as small as from 3 to 4 pounds. The spinal cord soured in pieces that were cured without splitting the backbone. Canning instead of curing and smoking is still recommended for lamb that is to be held for a long period.

An ice-chilled meat-curing box that can be made on the farm was designed, in cooperation with the Bureau of Agricultural Engineering, for use in the South. In tests on the box, temperatures as low as 36° F. were obtained with ice alone. Ice consumption for chilling and curing pork in this box varied between 1 and 2 pounds of ice per pound of meat.

BEEF AND DUAL-PURPOSE CATTLE INVESTIGATIONS

BEEF-CATTLE RESEARCH IN EASTERN UNITED STATES

Record-of-performance studies with beef Shorthorn steers at the United States Animal Husbandry Experiment Farm at Beltsville, Md., indicated that there were wide variations among purebred strains of Shorthorns in the efficiency with which they utilize feed. The range in time required to reach a finished weight of 900 pounds was from 370 to 503 days. Quantity of beef produced from 100 pounds of total digestible nutrients varied from 14.3 to 22.1 pounds with animals of similar type, fed alike on the same feeds.

For the fourth consecutive year grazing experiments have been carried on at Beltsville in cooperation with the Bureau of Plant Industry, to determine the rate of stocking and system of pasture management that will produce maximum cattle gains per acre on improved pasture of mixed seeding. These showed that heavy continuous grazing at the rate of one steer per acre produced the greatest gains, even though the alternately grazed paddocks contained more forage at all times. For the heavy continuous grazing the gains per acre were 208 pounds as compared with 195 pounds for the heavy alternate grazing and 144 pounds for the light continuous grazing at the rate of 2 acres per yearling steer. Likewise, heavy continuous grazing was found to be most favorable to the establishment of Canada and Kentucky bluegrass and white Dutch clover.

In cooperation with the Missouri Agricultural Experiment Station, at Sni-a-Bar Farms, Grain Valley, Mo., the efficiency of various feeds was studied in creep-feeding beef calves. Shelled corn and cottonseed meal resulted in greater and cheaper gains than ground corn and cottonseed meal. Adding molasses to either of these rations increased the feed consumption but not the gain.

BEEF-CATTLE RESEARCH IN THE SOUTH

A breeding project at the Iberia Livestock Experiment Farm, Jeanerette, La., to study the adaptability of Brahman-Aberdeen-Angus crossbred cattle to the Gulf coast region is under way. The project is of importance to the entire Gulf coast country, where a hardy type of beef animal is required.

Ten years' grazing records at the Coastal Plain Experiment Station, McNeill, Miss., show that on cut-over longleaf pineland, winter-burned areas produce fully one third more gain on beef cattle than unburned areas. The explanation for this has been found through analyzing the soil and the forage on such areas. Since winter burning has favored the growth of legumes, more nitrogen has been taken from the air on the burned areas and stored in the soil through the roots of the legumes. The grasses on the burned areas were more nutritious, containing about 30 percent more protein and 13 percent more mineral matter than the same grasses on the unburned area.

In 3 years' experimental work at Wenona, N.C., in cooperation with the North Carolina station, grade calves averaged 15 percent more gain than native calves on reed pasture during a 217-day summer grazing season. Grade yearlings averaged 18 percent greater gain than natives on similar winter rations.

Herd-improvement studies with native cows and Aberdeen-Angus, Brahman, Devon, and Hereford bulls were begun at Gainesville, Quincy, and Penney Farms, in cooperation with the Florida Agricultural Experiment Station.

Grazing experiments were established at the Chinsegut Hill Sanctuary, Brooksville, Fla., to determine the most profitable methods of improving and utilizing the forage production of sandy woodland, millions of acres of which are now tax delinquent in the South.

BEEF-CATTLE RESEARCH IN THE SOUTHWESTERN STATES

Experiments in Texas to determine the value of locally grown sorgos and sorghums as feeds for fattening steers have been carried on in cooperation with the State agricultural experiment station. At Big Spring, where steers were fed 184 days to determine whether grinding or threshing is desirable, the results of 2 years' work indicate that milo heads need not be threshed for steer fattening, but that they should be ground if used for this purpose. However, if threshed grain is used for steer fattening, it will give better results when ground. The results of experiments at Spur, Tex., indicate that red-top silage is distinctly superior to the dry roughage in fattening steers in the Southwest. Suitable silage was produced at low cost at the station by using a simple form of trench silo. The results of this experiment are of importance to the vast sorgo-producing areas of the Southwest, since steer-feeding affords a favorable market for locally produced feeds and enhances the value of the livestock marketed from the area.

BEEF-CATTLE RESEARCH IN WESTERN RANGE AREAS

Beef-cattle research dealing with problems in wintering cattle of different ages and with fattening steers on locally produced feeds has been carried on at the United States Range Livestock Experiment Station, Miles City, Mont., in cooperation with the State experiment station. The results of these experiments indicate that relatively small quantities of supplemental feed will prevent excessive loss of weight by cows wintered on the range with natural shelter. Losses of weight by cattle on winter range may be materially reduced by reserving adequate range for winter grazing and by feeding a supplement, such as 1 or 2 pounds of cottonseed cake a head daily, for from 1 to 2 months. Three-year-old range steers wintered as calves, yearlings, and 2-year-olds on a medium plane of nutrition were more profitable than those on either a high or a low plane. This should be of importance to the beef industry of the Northwest where great number of steers are carried through two or more winters.

Experiments over a period of 4 years at Ardmore, S.Dak., in cooperation with the Bureau of Plant Industry, have demonstrated that yearling steers in the northern Great Plains area may be wintered as satisfactorily on sorgo fodder as on alfalfa hay and straw. All groups were in satisfactory condition when turned on to spring range. These results are significant in view of the dependability of the sorgo fodder crop even under adverse seasons which frequently prevail in the dry-farming sections of this area. Another satisfactory method of wintering yearlings in this area was the reservation of suitable range for winter grazing, supplemented if necessary by a small quantity of hay or protein concentrate, or both.

DUAL-PURPOSE CATTLE RESEARCH

In research on dual-purpose cattle, 7 foundation herds of Shorthorns, 3 of Red Polled, and 1 of Devons are maintained at Federal and State stations. The same plan of work is followed at each station, but the feeds used are those which predominate in the locality. The plan is to begin with the most promising available cattle of the various breeds and by measuring the performance of their progeny to develop strains of known ability with respect to beef and milk production and feed utilization.

The first female of these matings to complete a year's milk record, finished as a junior 2-year-old and on two milkings a day, produced 8,613 pounds of milk containing 342 pounds of butterfat. The first 11 steers of these matings have been finished in record-of-performance tests showing wide variations in the efficiency with which beef is produced. They ranged from 425 to 523 in the number of days required to reach a finished weight of 900 pounds, and from 14.9 to 18.6 in number of pounds of dressed carcass produced for each 100 pounds of total digestible nutrients eaten. It is significant that one steer, highly efficient in the production of beef, was by the same sire as the junior 2-year-old heifer which completed her first lactation so creditably.

Records were kept of the milk, grain, and alfalfa hay consumed by 10 dual-purpose steer calves having an average birth weight of 85 pounds. At 505 pounds (weaning time) they had consumed 6.4 pounds of milk per pound of gain in weight, also an average, per steer, of 325 pounds of grain and 383 pounds of hay. With alfalfa hay at $20 per ton, grain at $25 per ton, and veal at 8 cents per pound, these calves at weights of from 150 to 505 pounds returned from $1.96 to $0.91, respectively, per hundredweight for milk. The latter figure is more than 20 cents per pound for butterfat with the calf doing its own milking.

In order to supply needed information for cattle improvement in the tick-free area of the Southeast, herds of native and improved cattle were established at different points in Florida. The average birth weight of the native calves born thus far was 50.5 pounds, of purebred Devons 61.4, and of purebred Red Polled 80.6. The average weight of the native calves which have reached 3 months of age was 153 pounds, of Devons 180 pounds, and of Red Polled, 220 pounds.

Data obtained indicate that early spring calves, sired by improved bulls bred to native cows, when nursed to a weight of from 175 to 225 pounds and marketed as veals at from 3 to 4 months of age, may be more profitable than when fed out as steers, as is the present practice in the area. This is especially the case where there is a shortage of pasture and roughage during the late summer and winter when steers would be fed out.

SHEEP, GOAT, AND ANIMAL-FIBER INVESTIGATIONS

Sheep, goat, and animal-fiber investigations have been conducted at 11 Federal and State experiment stations and 1 wool-scouring plant.

FARM-SHEEP INVESTIGATIONS

At Beltsville, Md., the sheep-carrying capacity of a mixed rye and wheat pasture was studied for the first time, and this study revealed the great advantage of such a pasture over one of either rye or wheat alone. The carrying capacity of this mixed pasture was 30.1 percent more than the recent 10-year average for wheat pasture and 90.2 percent more than the 10-year average for rye pasture on this same farm. The reason seems to be that wheat and rye together furnish a considerably longer grazing season and wheat withstands the winter better in combination with rye.

RANGE-SHEEP INVESTIGATIONS

At the United States Sheep Experiment Station, Dubois, Idaho, the development of the Columbia sheep has resulted in an outstanding accomplishment. During a period of 8 years Columbias produced heavier lambs and fleeces of clean wool than any of the breeds of sheep used by the Bureau at its experiment stations. The Columbia lambs at weaning time averaged 76.62 pounds and the scoured fleeces of the Columbia ewes 5.88. During this same period of 8 years, comparable figures for Rambouillets were respectively 71.16 and 4.81, for Corriedales 69.30 and 4.69, for Shropshires 60.24 and 4.37, and for Hampshires 73.33 and 4.01. The Columbias, Rambouillets, and Corriedales were all maintained at Dubois, Idaho; the Shropshires and Hampshires at Beltsville, Md. All the sheep in this test were purebreds and good specimens of their respective breeds.

In pursuing the study of Southdown sires for the production of range lambs at Dubois, it was found that the cash returns were greater for the lambs sired by Southdowns than for those sired by Rambouillets or Corriedales. For the last 2 years that this work has been in progress the Southdown-Corriedale lambs were most profitable, Southdown-Rambouillets second, Corriedales third, and Rambouillets fourth. In pounds of live lamb produced per ewe during each of the 2 years the Corriedale ewes bred to Southdown rams were first, Rambouillet ewes bred to Southdown rams were second, Corriedale ewes bred to Corriedale rams third, and Rambouillet ewes bred to Rambouillet rams fourth.

At Dubois the number of lambs born per 100 ewes bred and the weights and lengths of staple of fleeces were greater or less in direct relation with the abundance of rainfall, which has proved to be a dominating factor in the growth of range forage.

At Miles City, Mont., four sets of twin wether Rambouillet lambs were carefully selected at weaning time and sent to Beltsville, Md., for experimental purposes. Three of these sets were carried through a 112-day experiment on paired lamb feeding, in which each pair was a set of twins. One of each pair was fed a ration of corn, cottonseed meal, corn silage, and clover hay, whereas the other lamb was fed only corn silage and clover hay. The lambs receiving grain gained in weight and grade, whereas the lambs receiving only corn silage and hay lost in grade and made only small gains in weight. The grain-fed lambs gained 39 pounds per lamb, and those not fed grain 7 pounds. At the beginning of the experiment the lambs of both groups had an average grade rating of 3, or medium, as feeders, and at the close of the feeding period the grain-fed lambs had improved 1⅓ grades, whereas the lambs receiving no grain had deteriorated 1⅓ grades. It is certain, therefore, that Rambouillet lambs will not finish properly on corn silage and clover hay alone, but when these feeds are supplemented with corn and cottonseed meal the lambs make satisfactory gains and improve in grade or finish.

KARAKUL-SHEEP INVESTIGATIONS

Three top crosses of purebred Karakul sires on a foundation of Corriedale ewes have resulted in lambskin fur of such merit as to indicate that fur of high quality can be produced by such a system of top crossing. This is encouraging to fur-sheep raisers as it provides a method of getting into the production of fur without a great outlay of cash other than the purchase of good purebred Karakul rams.

STUDIES OF WOOL AND OTHER ANIMAL FIBERS

In studies to discover ways of improving wool production in the southern Appalachian area, fleeces of native sheep of the Hampshire type, at Hillsboro, W. Va., were found to yield the high average of 62 percent of clean wool. This information is valuable to the wool growers of the area as it definitely indicates the high value of their wools, in the grease, a shrinkage of only 38 percent being very light. It is well known that western range wool frequently shrinks as much as 62 percent.

At Hillsboro, Corriedale rams have been mated with native ewes, and fleece weights of the yearling daughters from this cross have been more than twice as great as the fleece weights of the native dams as yearlings.

The grease content of wool from Karakul sheep has averaged about 7 percent, which is only about two thirds the average for fleeces from sheep of the medium-wool breeds, about one half as much as for fleeces from Rambouillet sheep on western ranges, and only about one fourth as much as for the American Merinos in the fine-wool district of Ohio.

A simple, quick, and inexpensive method of determining clean-wool content and density of fleeces has been developed which can now be used by practical sheep breeders. This method is so much more accurate than mere judgment that it should greatly increase the efficiency of breeding for greater density and higher yields of clean wool per sheep and at the same time help to eliminate from the flock the sheep with extremely heavy shrinking fleeces that are so undesirable in the wool market. The details are available in a special publication.

The Bureau has developed a new method for determining fineness of wool. It has been further perfected and is being used by the wool industry in the United States, Canada, and Great Britain.

In order quickly to obtain cross-section views of wool fibers, there has also been developed a device for cutting cross sections of the bundles of wool fibers, taken from the above-mentioned device, in such a way as to facilitate examination under a microscope. The cross sections are seen in a standard space which enables the operator quickly to count the fibers and determine the relative fineness. This device also makes it possible to obtain promptly a photomicrograph of the cross-section view of the fibers which may be filed and used effectively in planning matings for a breeding program in wool improvement. Public service patents have been applied for on these two devices. These methods give promise of being of substantial aid in measuring the performance of sheep in wool production.

GOAT-MILK INVESTIGATIONS

The milk production of Saanen and Toggenburg does was compared at Beltsville, Md. The Saanen does produced an average of 1,313 pounds of milk during a lactation period of 262 days, whereas the Toggenburg does produced 1,055 pounds of milk in 250 days. The butterfat content of the Saanen milk averaged 3.6 percent and of the Toggenburg 3.4 percent. As the Saanen does were somewhat larger animals, the production was compared also on the basis of 100 pounds live weight. In this comparison the Saanen does also excelled, producing 1,028 pounds of milk during the period as compared with 949 pounds for the Toggenburgs.

In a comparison of goats' milk with Holstein and Jersey milk, Jersey milk produced the most rapid gains in laboratory animals and the Holstein and goats' milk less rapid gains, in the order named. No significant differences were found in the responses of the laboratory animals when equal quantities of nutrients in goats', Holstein, and Jersey milk were consumed. From the standpoint of a sole diet all were found to be deficient in iron. In order to determine the kind of bacteria in goats' milk, 82 especially drawn samples were studied. Forty-eight of these showed no evidence of bacterial life. Workers were able repeatedly to produce goats' milk containing less than 1,000 bacteria per cubic centimeter.

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In the samples showing bacterial life organisms commonly found were those associated with the skin glands and in general they appeared to have no action on milk.

The calcium content in the mixed milk of Saanen and Toggenburg goats ranged from 106 to 135 milligrams per 100 grams of milk, Holstein 97 to 117, and Jersey from 104 to 127. In phosphorus content, goats' milk ranged from 85 to 118 milligrams per 100 grams of milk, Holstein 79 to 95, and Jersey from 88 to 123. Among the more important characteristics studied, goats' milk was found to have a much softer curd than the milks of Holstein or of Jersey cows. The curd tension of the Holstein milk was about twice, and that of Jersey milk about three times that of goats' milk.

SWINE INVESTIGATIONS

Small, intermediate, and large type Poland China hogs were included in type studies conducted at Beltsville. In the spring of 1932 five small-type sows farrowed litters averaging 4.2 pigs and weaned an average of 2.0 pigs. Six intermediate-type sows farrowed an average of 6.7 pigs and weaned 5.8 pigs. Five large-type sows farrowed an average of 6.8 pigs and weaned 5.4 pigs. Pigs from the three types of sows were fed in separate groups from weaning to a final weight of approximately 225 pounds. Feed was utilized most efficiently by the pigs of large-type parentage. The intermediate and small types followed in order.

Twelve litters of the spring of 1932 and seven litters of fall farrow, the same year, were tested in connection with performance studies at Beltsville. Four pigs were used to represent each litter. They were on test from 72 days of age until they reached a final weight of approximately 225 pounds. The variation in average daily gain for the 12 groups of spring pigs was from 0.56 to 1.41 pounds. Feed consumed per 100 pounds gain ranged from 360.7 to 503.6 pounds. The seven groups of fall pigs ranged in average daily gain from 0.98 to 1.63 pounds, whereas the feed consumed per 100 pounds gain ranged from 336.2 to 396.1 pounds. Wide differences in efficiency of production were associated with differences in breeding among the groups. The importance of basing selections of breeding animals on progeny tests is emphasized by these results.

At Jeanerette, La., three different mixed pastures were compared by the use of fall-farrowed pigs. The pigs on each pasture received equal quantities of brewers' rice, daily, as a supplement. A fourth group, used as a control lot, was self-fed a ration of brewers' rice, tankage, and minerals, in dry lot. The most economical lot gained at the rate of 0.93 pound per pig per day and required 277.5 pounds of brewers' rice per 100 pounds gain, in addition to grazing a mixed pasture containing chess, Abruzzi rye, rescue grass, bearded barley, Nortex oats, and Italian ryegrass. The next lot in efficiency was that on a mixture of rape and Italian ryegrass. The lot that grazed on hairy vetch, purple vetch, Austrian winter peas, and Canadian field peas was the least efficient of the pasture groups. The results as a whole indicated a marked advantage from using pastures as compared with dry-lot feeding.

Analysis of data from a series of tests conducted at Miles City, Mont., shows that gilts from gilts farrowed an average of 7.7 pigs, gilts from old sows 8.9 pigs, and old sows 10.2 pigs. The respective percentages of pigs weaned were 72.7, 76.5, and 61.9. The pigs from each of the three groups of sows were fed under uniform conditions to a market weight of approximately 200 pounds. During this feeding period the pigs whose dams were gilts from gilts made an average daily gain of 1.35 pounds, those from gilts from old sows 1.43 pounds, and those from old sows, 1.40 pounds. The respective quantities of feed consumed by the pigs per 100 pounds gain were 382.8, 399.2, and 416.7 pounds.

Other factors than those mentioned above are involved in the selection of sows for the breeding herd. However, the results indicate that the use of gilts from gilts is not so satisfactory as the use of the other two groups of sows.

Dry lot and alfalfa pasture were compared for growing and fattening pigs at Ardmore, S.Dak. Shelled corn and tankage were self-fed in both lots. A summary of seven tests showed that the pigs on alfalfa pasture consumed about 8 percent less concentrates per unit of gain than the other group. Satisfactory finish was produced in both lots. Feeder pigs produced at Ardmore were shipped to the Kansas station at Manhattan for finishing in a series of tests, except in 1932 when the pigs were fattened at Ardmore. Each year the pigs were divided into several similar lots of not fewer than 10 pigs each. All lots were fed the same feeds under identical conditions. Among four lots in 1927 the range in quantity of feed consumed per 100 pounds gain was from 435 to 469 pounds, a difference of 34 pounds between the highest and lowest quantities. In 1928

among 4 lots the difference was 28 pounds; in 1929, among 3 lots, 46 pounds; in 1930, among 3 lots, 16 pounds; in 1931, among 3 lots, 10 pounds; and in 1932, among 3 lots, 50 pounds. These variations are of particular interest as indications of differences which may result even when conditions are uniform. They show that great care must be used in the interpretation of results of feeding tests.

HORSE AND MULE INVESTIGATIONS

Investigations in horse-husbandry problems pertaining to the West were continued at Miles City, Mont., with a stud of 254 animals. In a 140-day feeding test with weanling foals of light type to determine the value of adding grain to a good hay ration, foals on good alfalfa hay alone made very satisfactory gains but when whole oats were added to the ration somewhat better gains were made; 100 pounds of grain replaced 237 pounds of hay. The advisability of adding grain to a good alfalfa-hay ration depends on the comparative cost of the two feeds. In sections where alfalfa is the common hay produced, the relative cost as compared with that of good feed oats, is usually about 1 to 3 per unit of weight. Therefore the addition of grain to the ration would generally not be indicated.

Breeding, feeding, and management studies were continued during the year at the United States Morgan Horse Farm, Middlebury, Vt., with a stud of 61 animals. Demand for seed stock from this station continues to exceed the supply of surplus animals. During the year breeding animals were sent to the Governments of Cuba and Guam, the Georgia Experiment Station, and to several private studs. A project to determine the correlation of period of pregnancy with time of service indicated, from data compiled on 119 services, that mares bred early in the season have a longer period of pregnancy than mares bred later in the season. Mares bred in April carried the fetus 353 days; in May, 346 days; in June, 341 days; in July, 339 days; in August, 333 days; and in September, 326 days.

At Beltsville, Md., 18 foals were used in a study relating to rearing foals on substitutes for mares' colostrum and milk. This work indicated that normal horse serum used in place of colostrum for the first 24 hours and the use of adjusted dried cows' milk in place of mares' milk offer satisfactory and practical means of raising orphan foals.

CERTIFICATION OF ANIMALS IMPORTED FOR BREEDING

Under the provisions of paragraph 1606 of the Tariff Act of 1930, certificates of pure breeding were issued for 140 horses, 5,242 cattle, 598 sheep, 3 swine, 950 dogs, and 6 cats. The total number of animals of all breeds certified during the fiscal year was 6,939.

POULTRY INVESTIGATIONS

POULTRY BREEDING

Studies on the inheritance of egg production in Rhode Island Reds have shown that when the breeding stock is selected on the basis of the females' having laid 200 or more eggs during the first year of laying, the actual number of eggs laid by any bird does not indicate the breeding ability of that bird, nor does the egg production of the sire's dam serve as an index of the breeding ability of the sire. The mean egg production of the three nearest ancestors of the sire or dam has been shown to have no significant relationship to the production of the progeny. On the other hand, the mean egg production of the sire's and dam's nearest three female ancestors has been shown to be slightly significant in its relationship to the mean egg production of the dams. Further studies have shown that the mean egg production of each sire's daughters serves as the most readily available index of a sire's value for breeding purposes.

In studies on the inheritance of egg production of White Leghorns, in which the selection of the breeding stock was based on a minimum of 225 eggs the first laying year, practically the same results were obtained as for the Rhode Island Reds.

In a study of body type in relation to egg production, data obtained from body measurements show that there is no significant relationship between body type and egg production.

HATCHABILITY STUDIES

In studies on the physical and chemical nature of the egg, it has been established for the first time that the thick and the thin portions of the white differ principally in respect to their content of mucin.

Data obtained in a study of the turning of hens' eggs during incubation strongly indicate that more frequent turnings, by methods not now ordinarily used, give increased hatchability.

The incubation of hens' eggs with the long axis at an angle of 30° from horizontal and with frequent turning of the eggs back and forth and up and down simultaneously resulted in an increase of 8 percent in hatchability over eggs turned by hand or by mechanical means similar to that used in commercial incubators.

In a study of the effect of different meat meals and meat-and-bone meals on hatchability, it was found that although a given product may be very satisfactory for the growth of rats and for egg production in chickens, it may be unsatisfactory for the production of hatchable eggs.

All-plant diets were shown to be inadequate for the production of hatchable eggs for confined birds but seemed reasonably satisfactory when fed to birds on blue-grass range.

POULTRY FEEDING

Poultry-feeding studies have shown that vitamin A is of distinct value for maintaining the life of chicks fed diets deficient in protein. Fresh alfalfa, cod-liver oil, and yellow carrots were found to be richer in vitamin A than sun-cured alfalfa meal or sun-cured alfalfa-leaf meal. It was also found that sun-cured alfalfa meal is much less satisfactory than sun-cured alfalfa-leaf meal.

Increasing the protein in the diet of laying hens tended to increase egg production and the number of eggs per pound of feed; diets containing proteins only from vegetable sources had a tendency to increase second-week embryonic mortality as well as chondrodystrophy.

Hens receiving 2 percent of cod-liver oil in their diet produced eggs containing about one and one half times as much vitamin D as eggs from hens receiving 1 percent. On increasing the cod-liver oil to 4 and 6 percent, little or no increase in the vitamin D potency of the eggs resulted. On the other hand, when viosterol was fed, the amount of vitamin D in the eggs increased with fair regularity as the potency of the viosterol was increased.

The feeding of certain inorganic sulphur compounds to laying hens has no consistent effect on the length of the molting period. Thus it has been demonstrated that the practice of including flowers of sulphur in the diet of chickens is not effective in shortening the molt.

When confined birds received cod-liver oil and sunshine in addition to their regular diet, they laid not only as many eggs but also had a tendency to lay larger eggs than birds which also had access to limited range. When the confined birds received sunshine but not cod-liver oil, neither their production nor egg size was significantly different from that of the eggs of birds given access to a limited range.

Scabbed barley, which is not tolerated by swine, is readily consumed by chickens and is of virtually the same value as normal barley.

The kind of phosphorus, whether organic or inorganic, as well as the quantity, in the diet of growing chicks is important in determining whether perosis will develop and how severe the case will be. The inorganic-phosphorus content should be kept as low as possible, especially when the total phosphorus tends to exceed 0.7 percent.

BIOCHEMIC DIVISION

The work of the Biochemic Division, under M. Dorset, chief, consisted mostly of investigations on hog cholera, biological products used in diagnosing disease, dips and disinfectants, and research on problems concerning meats and meat food products.

HOG-CHOLERA INVESTIGATIONS

For use in experimental work, there were produced during the year at the Bureau's farm at Ames, Iowa, 91,675 cubic centimeters of anti-hog-cholera serum and 42,799 cubic centimeters of hog-cholera virus. In addition, there were collected 104,350 cubic centimeters of serum which resulted from studies of different processes of hyperimmunizing and bleeding. Considerable quantities of serum are required annually in work with the Animal Husbandry Division in continuing a study of the immunization of suckling pigs.

EFFECT OF HEAVY BLEEDING OF HYPERIMMUNES ON POTENCY OF ANTI-HOG-CHOLERA SERUM

It was originally the practice in the production of anti-hog-cholera serum to take 5 cubic centimeters of blood, at each bleeding, per pound weight of hyperimmune hog. In recent years, for reasons of economy, this practice has been varied at many commercial establishments by increasing the quantity of blood drawn at each bleeding. In some case as high as 8 cubic centimeters per pound has been drawn from the hyperimmune. Such a practice, tending to reduce the cost of serum, is desirable provided the potency of the serum is not thereby materially reduced.

During the year 24 immune hogs were hyperimmunized in the usual manner. These hogs were handled in groups, the same virus being used for all hogs in a group. Half of these hyperimmunes were bled to the extent of 5 cubic centimeters, per pound of hog, at each bleeding, whereas the others were bled to the extent of approximately 8 cubic centimeters. Each hyperimmune was subjected to four bleedings and the serum thus obtained from each hog was tested separately and in mixture, that is, the serum from regular bleeders was mixed as was the serum from the heavy bleeders. In some cases the serum from the heavy bleeders appeared to be distinctly lower in potency than that obtained from the regular bleeders. In other cases no difference could be discerned. The present information indicates that heavy bleeding tends to reduce the potency of serum though entirely satisfactory serum may in many cases be obtained thereby. The data thus far obtained do not warrant any present change in the regulations regarding bleeding of serum-producing hogs, particularly since the potency of serum marketed by licensed establishments is determined by test before the product is released from the establishments.

EFFECT OF HYPERIMMUNIZING DOSE ON SERUM POTENCY

For the fiscal year ended June 30, 1931, a report was made on experiments to determine the effect of reducing the dose of virus used for hyperimmunizing on the potency of the resulting serum. The use of less hyperimmunizing virus would tend to reduce the cost of serum production. The earlier experiments indicated that the dose of hyperimmunizing virus might be reduced without affecting the potency of the serum.

During the last year further studies on this question were carried out. The tests indicated, on the whole, that there was a slight but distinct lowering of potency of the serum obtained from hyperimmunes which received the reduced hyperimmunizing dose of virus. These results are somewhat at variance with those reported in 1931. The difference is ascribed to the use, during the last year, of smaller graduated doses of serum which better permit the detection of differences in potency. From these results it appears that it would be unwise to lower the present hypering dose of 5 cubic centimeters of virus per pound.

PERSISTENCE OF VIRUS IN THE BODIES OF SIMULTANEOUSLY TREATED PIGS

Previous experiments have shown that viable hog-cholera virus remains in the blood of simultaneously treated pigs for several weeks after inoculation. Recently European investigators have reported that the virus persists in the lymph glands of simultaneously treated pigs for as long as 10 months after immunization. To determine whether pigs treated by the simultaneous method in this country remain carriers of the virus in lymph glands, six pigs were given a simultaneous injection of 35 cubic centimeters of serum (defibrinated blood) and 2 cubic centimeters of virus. These pigs, kept in isolated pens under daily observation, remained entirely normal. At the end of 3 weeks three of these pigs were killed, the blood was collected and preserved, and the mesenteric, portal, bronchial, cervical, and inguinal glands were macerated with salt solution and used to inject suitable pigs. Twelve pigs were used for the injection of blood and gland suspension. The results of the injections were that the pigs receiving defibrinated blood remained well. Two of the 10 pigs injected with the gland material became sick, one developing a typical attack of acute hog cholera. It thus appeared that 3 weeks after simultaneous inoculation the virus was present perhaps in small quantities in the glands after it had disappeared from the blood. The remaining three simultaneously treated pigs were killed at the end of 6 weeks and the glands and blood tested. All these pigs remained well, thus indicating that the virus may persist at times in the lymphatic glands of simultaneously treated pigs for 3 weeks but that in these experiments it had disappeared at the end of 6 weeks.

IMMUNIZING VALUE OF DEFIBRINATED BLOOD VIRUS AND CLEAR VIRUS

A large part of the virus in the blood of sick hogs is attached to the cells. For this reason the whole defibrinated blood is used for simultaneous inoculation, this practice being supported by the belief of many that a better immunity is obtained by using the whole-blood virus than by using a clear virus. A series of experiments has been carried out to compare them in simultaneous inoculations. Three different lots of virus were used in the treatment of four farm herds, approximately half of each herd receiving anti-hog-cholera serum and whole-blood virus, the other half of the same herd receiving the same serum and clear virus. The dose of virus in all cases was 2 cubic centimeters. A total of 233 pigs was given the simultaneous treatment, 116 receiving the clear virus and 117 the whole-blood virus. Approximately 3 months after the simultaneous inoculation 60 of these pigs were tested for immunity, half having been treated with clear virus, the other half with whole-blood virus. All the pigs withstood the exposure in good condition. These experiments, though not extensive, seem to indicate that it may be possible to use a clear virus for the production of a satisfactory immunity. The clear virus, owing to the removal of the red blood cells, can be kept in better condition and is perhaps more easily preserved. Work along these lines will be continued.

INFECTIOUS ENTERITIS IN YOUNG PIGS

During the year the Bureau's attention was directed to the occurrence of extensive losses of young pigs at a number of large garbage-feeding plants. The heaviest losses were in pigs from 3 to 5 days old. It was determined that the disease was not hog cholera but instead an acute enteritis characterized by diarrhea and extreme weakness. The post-mortem lesions consist chiefly of severe inflammation of the small intestine, confined usually to the duodenum and jejunum. Bacteriological studies have indicated that the immediate cause of the enteritis was *Bacillus coli*, which appeared to invade through the intestinal mucous membrane. Further studies showed that extensive abortion-disease infection existed in the herds, and it is probable that this was the primary factor in lowering the resistance of the young pigs, permitting infection by *Bacillus coli*.

STABLE FLIES IN RELATION TO HOG CHOLERA

During the summer and fall of 1932 weekly counts of stable flies captured in traps in central Iowa were made to gather further data concerning the relationship, if any, which exists between the prevalence of stable flies and hog cholera. The data obtained showed a marked increase in stable flies during the first part of August. The number then diminished until the first of September when there was again a marked and sudden increase in the number of flies during the first 2 weeks of that month. A study of hog-cholera outbreaks occurring in Iowa during the same period showed two high points in the hog-cholera curve. One of these peaks was reached the latter part of August and the second the latter part of September. In each case the peak of hog-cholera prevalence followed the peak of stable-fly prevalence by about 2 weeks. These observations are, of course, not conclusive but they augment similar data previously obtained.

WHITE BLOOD CELLS IN HOG CHOLERA AND RELATED DISEASES

During the year white-blood-cell counts were made on several pigs in different herds showing clinical manifestations of infectious enteritis. The counts indicated that a leucocytosis may be expected in infectious enteritis. Other observations on the leucocyte count in hog cholera made on pigs from farm herds gave irregular results, in some cases a leucopoenia, in others leucocytosis. Although hog cholera is usually characterized by a leucopoenia, this is probably marked at times by secondary infections which produce a leucocytosis.

TUBERCULIN AND MALLEIN

The preparation and distribution of tuberculin and mallein for official use by Bureau and State officials were continued. The year's output of tuberculin was as follows: Subcutaneous tuberculin, 115,000 cubic centimeters; intradermic tuberculin, 1,600,370 cubic centimeters; ophthalmic tuberculin, 7,140 disks; avian intradermic tuberculin, 11,145 cubic centimeters.

More than half of the intradermic tuberculin produced during the year was prepared from cultures of *Mycobacterium tuberculosis* on the synthetic medium which has been referred to in previous reports. During the year data have been

assembled on comparative intradermic tests of the tuberculin prepared from the synthetic medium and the regular Koch tuberculin. From a total of 19,768 cattle tested comparatively there were removed 1,444 tuberculous cattle. Of these, 1,443 reacted to the tuberculin from the synthetic medium, whereas 1,297 reacted to the regular tuberculin, thus indicating a failure on the part of the regular tuberculin in approximately 10 percent of the cases.

It is interesting to note that the percentages of no-lesion cases resulting from testing with the two forms of tuberculin were practically the same. With the tuberculin prepared from the synthetic medium the percentage of no-lesion cases based on the number of reactors was 5.3, whereas with the regular tuberculin the percentage was 5.5. The tuberculin prepared from the synthetic medium is unusually well supplied with the specific protein responsible for the reaction in tuberculous cattle. The methods employed by the Bureau have been adopted recently by the National Tuberculosis Association as the standard for its production of tuberculin for use in the study of the human disease.

STAINED ANTIGEN FOR PULLORUM-DISEASE DIAGNOSIS

During the year stained antigen for experimental purposes sufficient to make 300,000 tests has been furnished to cooperating State officials. In addition, permits have been issued by the Secretary of Agriculture to 7 additional establishments to produce stained pullorum-disease antigen, making a total of 24 establishments which have been given permission to produce this antigen under the rules of the Chief of the Bureau of Animal Industry. The results indicate that this antigen will be of real service to the poultry industry. In the meantime laboratory studies of the antigen have been continued, and it has been found that various cultures of *Salmonella pullorum* produce rough and smooth types of colonies. Antigens from the smooth types were found to be much superior to those from the rough types. This matter is being given further study with the idea of better standardizing the product.

INVESTIGATIONS OF DIPS, DISINFECTANTS, AND ANTHELMINTICS

Routine laboratory analyses were made of 140 samples of dips, disinfectants, serums, and analogous products. During the year there were prepared and forwarded to inspectors in the field the following: 150 new outfits for testing arsenical dipping baths and supplies to make 362,000 field tests; 6 new outfits for testing lime-sulphur dipping baths and supplies to make 7,700 field tests; supplies to make 2,295 tests of nicotine dipping baths; 1 outfit and supplies to make 4,400 tests for phenol in viruses, serums, and analogous products; and supplies to make 300 tests of disinfectant for sausage casings.

A Federal inspector finding that the field assay of arsenical dipping baths was almost impossible to execute on baths prepared from dark-colored peaty waters in certain sections of Florida, worked out a method of clarification preliminary to assay, involving the addition of alum followed by filtration. Tests of the method in the laboratory and the field showed its reliability, convenience, and other advantages under the conditions mentioned. Consequently 50 outfits for clarification, with the necessary supplies, are being prepared for shipment to the field for use where excessively dark-colored baths are encountered.

During the year a study has been made of the influence of variations in acidity and alkalinity upon the stability of hypochlorites. It has been established that hypochlorites are most stable near pH 13.2.

Studies of disinfectants for use against infectious abortion have shown that laboratory tests made on pure cultures are not always an accurate guide to the effectiveness of disinfectants when applied in a practical way. For example, disinfectants in a concentration which destroyed *Brucella abortus* in pure culture were found to be ineffective when applied to milk drawn from the udders of infected cows. Further studies are being conducted with the object of obtaining a practical, effective disinfectant.

Solutions of orthophenylphenol in coconut-oil soap have been found to be effective for killing fleas on dogs and cats and in kennels and similar places. A stock solution containing 20 percent of coconut-oil soap and 5 percent of orthophenylphenol is diluted with warm water in the proportion of 1 to 50 and used as a shampoo for dogs or cats. No toxic effect has been noted, even with much stronger solutions. The above-mentioned solution, besides being effective for killing fleas, is also antiseptic and promotes the healing of cuts and other external injuries. One percent of orthophenylphenol dissolved in milk of lime was found to be effective, when sprayed over the interior of chicken houses, in ridding them of mites.

In cooperation with the Zoological Division the study of the relation between chemical constitution and anthelmintic power was continued. The results indicate that the substitution of fluorine for part of the chlorine in fully chlorinated hydrocarbons, such as hexachlorethane, markedly increases anthelmintic power.

MEATS AND MEAT FOOD PRODUCTS

A study of the influence of various factors on the activity of proteolytic enzymes concerned in the ripening of meats and meat food products has shown that the reaction has a very important effect upon the extent and rate of proteolysis. Optimum results were obtained at a reaction of approximately pH 4.9. As was to be expected, proteolysis was more active at incubator temperature than at temperatures near freezing. It is noteworthy, however, that very marked proteolysis took place in liver even at 34° F. Proteolytic action was more marked in pork and calf livers than in the meat from the corresponding animals.

In continuation of previous study of the distribution of vitamins in meats and meat byproducts, beef and pork hearts were found to be excellent sources of vitamin G, comparing favorably with beef and pork livers, in this respect.

EXPERIMENT STATION

The work of the Bureau's Experiment Station at Bethesda, Md., conducted under the supervision of W. E. Cotton, superintendent, consisted, as in past years, in making independent investigations and providing facilities for other divisions of the Bureau. The station's investigations consisted principally of researches on infectious abortion, tuberculosis, and vesicular stomatitis.

INFECTIOUS ABORTION

An experiment dealing with the skin as a route through which cattle may be infected with *Brucella abortus* has been concluded and the results published. Four pregnant cattle were exposed through the abraded skin and 16 through the intact skin. A single application of a *Br. abortus* suspension to the abraded skin resulted in the transmission of Bang's disease to all four animals. Of the 16 cattle exposed through the intact skin, 10 acquired the disease.

To gain more definite information concerning the infectiousness of *Brucella abortus* of the swine type for cattle, 6 pregnant heifers, negative to the agglutination test, were placed in a pen about 30 yards square with 3 boars and 3 pregnant sows that had been artificially infected with virulent *Br. abortus* of the swine type. Two pregnant sows, negative to the agglutination test, were placed in the pen as controls. To make the exposure of the cattle in the small enclosure more severe, hay was fed from the ground and cattle and swine occupied the same shelter. Furthermore, the pen was purposely kept in an insanitary condition. The exposure continued until all the heifers had given birth to calves. That at least some of the hogs were eliminating *Br. abortus* was evidenced by the 2 control sows becoming infected, as proved by guinea-pig inoculations. Two of the heifers reacted to the agglutination test in titers of 1:25 and 1:200, respectively, 6 weeks after the beginning of exposure, but both were negative 6 weeks later. The remaining 4 heifers did not react. All 6 heifers produced vigorous calves, and none were proved to harbor *Br. abortus* in either the uterus or udder. The results indicate, as have also those of previous work, that *Br. abortus* of the swine type is of low pathogenicity for cattle.

To determine whether milk of cows infected with *Brucella abortus* is a source of danger to pregnant cattle, 2 pregnant heifers and 1 pregnant cow, negative to the test for abortion, were fed the raw mixed milk from 3 infected cows, and a third pregnant heifer, also negative to the test, was fed the milk of a similarly infected cow. The 4 cows from which milk was fed were proved by guinea-pig inoculations to be eliminating *Br. abortus* from their udders. One of the 2 heifers fed the mixed milk received during 3 consecutive months a total of 49,500 cubic centimeters in 32 feedings; the other, 44,300 cubic centimeters in 28 feedings; and the cow, 40,700 cubic centimeters, also in 28 feedings during the same period. The heifer fed milk of a single infected cow was given 19,900 cubic centimeters in 21 feedings extending over a 2-month period. Agglutination tests made of the exposed animals at 15-day intervals throughout the experiment were negative in all cases, and all 4 animals produced vigorous calves. Thus far it appears that the repeated feeding of milk contaminated with *Br. abortus* failed to transmit the disease to any of the 4 animals.

To obtain information on the infectiousness of both the bovine and swine strains of *Brucella abortus* for sheep, 10 ewes, negative to the agglutination test for infectious abortion, were placed in an enclosure with a ram and about 3 months later 5 of them were exposed to the bovine type of *Br. abortus* and 5 to the swine type; the cultures used were the eleventh transfer of the bovine strain and the sixth of the swine strain. Two ewes of each group were exposed via the conjunctiva, 1 via the scarified skin, and 2 by ingestion. Of the 5 ewes receiving the bovine strain, 4 appeared to lamb normally, but it was proved by guinea-pig inoculations that *Br. abortus* was present in the uterine fluid of all of these and in the colostrum of 3. The fifth ewe died in advanced pregnancy, and the presence of *Br. abortus* was demonstrated in material taken from her uterus. *Br. abortus* was also isolated culturally from her spleen and one kidney. In the group receiving the swine strain, 2 ewes appeared to lamb normally and the presence of *Br. abortus* could not be demonstrated in either their uteri or colostrum. Two ewes aborted. *Br. abortus* was found to be present in the uterus and colostrum of one of these but not in the other. The fifth ewe died in advanced pregnancy, and *Br. abortus* was present in her uterus and colostrum. Although the results indicated that sheep can be artificially infected with *Br. abortus* of both the bovine and swine types, further studies will be required to determine whether they can be infected with either type of the micro-organism by natural exposure.

To gain further information on the responsibility of infections other than *Brucella abortus* for abortions in cattle, 1 pregnant heifer was subjected to conjunctival and ingestion exposure with the stomach contents of an aborted fetus in which the presence of vibrios had been demonstrated, and 2 pregnant cows were injected intravenously with a streptococcus that was suspected of being responsible for the occurrence of abortion in a heifer. The 3 animals produced vigorous calves, and no evidence was obtained that the infections to which they were exposed became established in them.

Through researches and numerous tests of commercial abortion vaccines, aid was given the Division of Virus-Serum Control in modifying requirements for vaccine preparation so as to render such vaccines safer and more uniform. In cooperation with the Meat Inspection Division, studies were made of swine carcasses showing vertebral lesions suspected of being caused by *Brucella abortus*, to determine whether the organism could be found in the visible lesions and in organs or parts remote from them. Although *Br. abortus* was isolated in a number of instances from diseased lumbar and sacral vertebrae in the carcasses studied, its presence was not demonstrated elsewhere except in nearby lymph glands.

Studies of vaccination as a means of combating Bang's disease, continued during the year, yielded encouraging results. Two vaccine experiments were completed during the year and the results published. One dealt with the efficacy and safety of abortion vaccines prepared from *Brucella abortus* strains of different degrees of virulence and the other with the efficacy of an avirulent strain of *Br. abortus* for the vaccination of pregnant cattle. The results of a third vaccine experiment which was completed the previous year, in which both nonpregnant and pregnant cattle were vaccinated either with an avirulent or virulent strain of *Br. abortus*, were also published.

A calfhood vaccination experiment begun in 1929 has now been practically completed. Seventeen heifers vaccinated during calfhood and 16 controls were given equal exposures to *Brucella abortus* via the conjunctiva following conception. Sixteen of the principals produced vigorous calves and one produced a weak calf. *Br. abortus* was isolated from uterine material and colostrum of the dam which gave birth to the weak calf and from the colostrum of one of the heifers which produced a vigorous calf. Efforts to isolate *Br. abortus* from the uterine material and colostrum of the other 15 principals failed. Of the 16 controls, 7 aborted and 3 produced weak calves. *Br. abortus* was isolated from the uterine material and colostrum of 8 of these 10 heifers. In two instances cultural results were not determined. Six of the controls produced vigorous calves. *Br. abortus* was isolated from the uterine material and colostrum of one of these controls and from the colostrum of another. Efforts to isolate *Br. abortus* from the uterine material or colostrum of the remaining 4 controls failed. The results, therefore, definitely indicated the presence of a serviceable immunity in the animals vaccinated when they were calves. By administering the vaccine during calfhood, it was found possible to eliminate largely the objectionable features that sometimes accompany the vaccination of mature animals.

A vaccine experiment, begun during 1932, making use of 37 unbred heifers near breeding age to gain further information on the immunizing value of an

avirulent *Br. abortus* strain as compared with strains possessing different degrees of virulence, is almost completed. The results thus far indicate that the avirulent *Br. abortus* strain used no longer possessed virtue as an immunizing agent for virgin heifers near breeding age, also that a *Br. abortus* strain of low virulence used as an immunizing agent against the exposure given, was apparently as effective as the virulent strain.

The cooperative abortion-disease projects, begun in 1929 with eight State universities and experiment stations and covering numerous phases of the abortion-disease problem, were continued. Several of these projects have yielded results which have either been published or prepared for publication.

TUBERCULOSIS

Studies of so-called "skin-lesion tuberculosis" were continued throughout the year. Two apparently identical strains of acid-fast organisms recovered from skin lesions were injected into cattle, causing swellings similar in appearance to the original skin lesions. These swellings resolved after 4 months, except in one bovine animal which still harbored a small nodule 1 year after inoculation. The inoculated cattle manifested a slight tuberculin sensitization which disappeared with the resolution of the lesions. The soil acid-fast organism mentioned in last year's report, although similar in appearance to the skin-lesion organism recovered from cattle pasturing on this soil, failed to produce lesions or sensitize to tuberculin in either guinea pigs or cattle.

Data have been assembled relative to various agents capable of sensitizing cattle to tuberculin. Field reports from areas in which bovine tuberculosis has been practically eliminated, but in which tuberculosis in fowls is prevalent, give further indication that the avian type of tubercle bacillus is capable, at times, of causing a slight sensitization to tuberculin in cattle when the cattle and infected fowls are in contact with each other.

A recent report made by a European investigator that cattle supposedly free from tuberculosis but affected with the *Brucella abortus* organism react at times to tuberculin, prompted an investigation of this subject. Twelve guinea pigs were infected with *Br. abortus*, and skin tests with tuberculin were made at weekly intervals for a period of 4 months. No tuberculin sensitization was noted. The tuberculin-test records of this station for 20 years also fail to disclose a single instance in which a bovine animal affected with abortion disease has reacted to tuberculin without showing lesions of tuberculosis on autopsy. Several hundred negative tuberculin tests of abortion-disease-infected cattle have been recorded.

Field reports indicating that tuberculosis is spread in baby chicks hatched in commercial hatcheries from eggs of tuberculous hens, have made a reinvestigation of this subject appear urgent. Preliminary examination, for living tubercle bacilli, of a few samples of dust from commercial hatcheries using the forced-draft type of incubators, has so far failed to incriminate the dust as a possible factor in the spread of this disease.

Purity and potency tests of 46 samples of avian and mammalian tuberculins, produced by commercial biological concerns in the United States, were made during the past year. For the first time in the history of such testing all tuberculins were classed as satisfactory.

VESICULAR STOMATITIS

Two known types of virus of vesicular stomatitis have been kept alive by passages through guinea pigs for approximately 7 years. Both types are still virulent for cattle and horses. Use has been made of the virus to test the degree of thermal treatment of certain products required to make them safe for importation from a disease standpoint. A small stock of guinea pigs, immune to each type of virus, has been kept on hand to help determine the identity of any material received, suspected of being foot-and-mouth disease, and use was made of some of them during the year.

FIELD INSPECTION DIVISION

The Field Inspection Division, under George W. Pope, chief, continued activities relating to control and eradication of various animal diseases, especially scabies in cattle and sheep and dourine in horses. This division also administered regulations based upon specific laws designed to protect livestock of the United States from diseases of foreign origin and to assure the humane handling of export ani-

mals and the shipment to foreign countries of only those proved to be free from disease.

ERADICATION OF SCABIES

Sheep-scabies eradication, carried on in cooperation with State livestock sanitary authorities, was continued. Employees in the field made 19,366,650 inspections and supervised 2,264,555 dippings. Sheep in the herds in which infection was found totaled 227,259. Satisfactory progress was made toward final eradication of the disease in all but two of the States with which the Bureau cooperates actively. The infection existed principally in three circumscribed areas, and in one of those an eradication campaign has already been completed. The range areas in all that region lying to the north and west of Nebraska, Colorado, New Mexico, and Arizona are at this time free from the disease. Texas and Oklahoma also continued to be free. In Colorado, Arizona, and Kentucky the infection was reduced to 2 or 3 possible centers in each. On the Navajo Indian Reservation, where an intensive campaign has been in progress in cooperation with the Bureau of Indian Affairs, Department of the Interior, it appears that sheep scabies has been practically, if not entirely, eliminated.

The rather widespread existence of sheep scabies on farms and feed lots in the Central States still prevails; however, a considerable reduction in the number of infected flocks or premises was achieved during the year.

Cooperation with State livestock sanitary officials in the eradication of cattle scabies was also continued, 2,697,251 inspections having been made and 435,673 dippings supervised by Bureau employees. Cattle in infected herds numbered 165,595. Practically all this infection is confined to four States. All the States to the north and west of Wyoming, Colorado, and New Mexico, and both Texas and Oklahoma to the eastward, are entirely or practically free from infection.

Several centers of sarcoptic scabies of cattle have engaged the attention of Bureau and State employees in the Western States. With the exception of an area in Colorado, eradication measures have been successful.

Cooperative efforts to eradicate scabies of goats in Texas proceeded during the year, satisfactory progress being made. Infection was found in only five herds containing 2,452 animals, and the treatment of these herds was in progress at the close of the year.

Scabies of horses, which existed extensively on the Blackfeet Indian Reservation in Montana in previous years, is present to only a slight extent according to inspections made during the year.

ERADICATION OF DOURINE

The campaign to eradicate dourine on the San Carlos Indian Reservation in Arizona, which was begun the previous year by the Bureau of Indian Affairs and this Bureau, was completed and it is believed that the disease has been entirely eliminated from that area.

In the only area now known to harbor dourine infection, which includes parts of Oregon, Idaho, and Nevada, blood samples for test were taken from time to time from slaughter horses originating in that area, so that information concerning the possible spread of the disease may be available. These tests indicated that infection exists to a slight extent only. The number of horses in the area is diminishing through slaughter. In the meantime the area is under State quarantines. A complete report of the animals tested and the results of the tests appear on page 32.

CONTROL OF ANTHRAX

Bureau forces in South Dakota and Nebraska cooperated with State and local authorities in checking serious outbreaks of anthrax and in measures to prevent recurrence. The livestock on several Indian reservations were involved and assistance was extended, especially to the Indian Service in that part of the control campaign.

INTERSTATE SHIPMENTS OF LIVESTOCK

Horses and mules numbering 1,459 were inspected by Bureau veterinarians for interstate movement in compliance with requirements of the States of destination. Of these, 512 were tested with mallein for glanders, all being found free from the disease. This service was furnished by Bureau employees in connection with their regular duties.

CONTROL OF COMMUNICABLE POULTRY DISEASES

No outbreak of European fowl pest or other serious diseases of poultry occurred during the year. The Bureau continued to supervise the cleaning and disinfection of poultry cars, 9,756 cars being thus treated under supervision. As there has been no case of European fowl pest in this country for several years, the arrangement with the live-poultry transportation interests whereby this supervision was furnished was discontinued at the close of the year.

INSPECTION AND QUARANTINE OF IMPORTED ANIMALS

As provided by regulations of the Department, inspection was made of all horses, ruminants, and swine, from foreign countries, when they were presented for importation at coast and border ports of entry. Domestic ruminants and swine are prohibited importation by law from countries in which foot-and-mouth disease exists, and as a result of the prevalence of this infection in many parts of the world there were few countries from which animals of this kind could be imported. Canada and Mexico were the chief sources of supply, followed by the Virgin Islands from which there were several shipments of cattle to Puerto Rico. The only domestic ruminants imported from the Eastern Hemisphere consisted of cattle from the Channel Islands. The number and kind of animals imported are shown in table 1.

TABLE 1.—*Animals imported, fiscal year 1933*

INSPECTED BUT NOT QUARANTINED

Port of entry	Cattle	Swine	Sheep	Goats	Horses and mules	Asses	Other animals
Baltimore					4		4
Boston					29		
Key West					230		
Los Angeles					46		
New York					224		1
San Francisco					2		
San Juan, Puerto Rico	1,661	38	1	24	55	2	31
Canadian border ports	8,117	910	1,261	13	8,369		85
Mexican border ports	[1] 88,978		1	118	12,031	4	34
Total	98,756	948	1,263	155	[2] 20,990	6	155

INSPECTED AND QUARANTINED

Boston							7
Los Angeles							3
New York	89				4	5	18
San Francisco					18		
Canadian border ports		110					
Total	89	110			22	5	28

[1] In addition to those shown in the table, 3,238 Mexican cattle passing through the United States under bond were inspected at the time of entry.

[2] Of this number 181 were mules.

Two hundred and ninety-six domestic fowls, chiefly from Europe, were inspected at ports of entry. Inspectors of the Bureau at Mexican border ports inspected and supervised the quarantine of 1,300 quail from Mexico. This was done in cooperation with the Bureau of Biological Survey.

During the year the Bureau has received cordial cooperation from the Public Health Service and customs officials in the enforcement of regulations to prevent entry, into United States ports, of vessels having on board sea-stores livestock from countries in which either foot-and-mouth disease or rinderpest exists. The number of vessels found carrying prohibited livestock of this kind was far less than during the previous year. Eleven vessels were held. These carried but 17 head of livestock which were slaughtered followed by disinfection of the pens occupied by them on the vessels. Port quarantine officers of the Public Health Service, in cooperation with the Bureau, obtained declarations during the year from 10,148 shipmasters, reporting the existence or absence on their vessels of prohibited livestock and animal products. The presence of prohibited meats on 3,073 vessels was declared in this manner.

IMPORTATION OF ANIMAL BYPRODUCTS, FEEDING MATERIALS, ETC.

Regulations designed to prevent the introduction into the United States of anthrax, foot-and-mouth disease, and rinderpest, through the medium of import hides, skins, other animal byproducts, and feeding materials were carefully administered. These various restricted import products were handled so as to protect fully our domestic livestock. Also through chlorination or other treatment of effluents from tanneries and like establishments there has been no known contamination of streams and lands with anthrax.

Calf stomachs for the manufacture of rennets, also endocrine and other animal glands for the preparation of biological products, were handled under restrictions unless the country of origin was known to be entirely free from foot-and-mouth disease and rinderpest.

Animal manure was not allowed importation from any country without a special permit.

Careful control was maintained over hay and straw packing materials and previously used bags. There was evident an inclination on the part of importers of merchandise from countries infected with foot-and-mouth disease to require their foreign agents to discontinue the use of all second-hand bags.

Special care was given to the enforcement of regulations prohibiting the landing of fresh or frozen meats or garbage derived therefrom in all cases of vessels which had provisioned in regions where foot-and-mouth disease exists. Quarantine officers of the Public Health Service, collectors of customs, and local sanitary authorities at ports of entry were all materially helpful in the enforcement of this requirement.

Cars numbering 2,715, used for transporting restricted import materials to tanneries or other manufacturing establishments in the United States, were disinfected following their use.

INSPECTION OF ANIMALS FOR EXPORT

During the year 29,688 animals were inspected prior to their exportation. This was an increase of nearly 10,000 over the previous year. Inspections were made of all vessels transporting export livestock in order to assure compliance with requirements as to space, fittings, and equipment for humane treatment and safe transport of the animals. The number of animals of various kinds inspected for export is shown in table 2.

TABLE 2.—*Inspection and testing of animals [1] for export fiscal year 1933*

Kind of animal	To Canada	To other countries	Total	Kind of animal	To Canada	To other countries	Total
Cattle	98	2,879	2,977	Mules	39	1,472	1,511
Swine	5	[2] 18,866	18,871	Asses	-------	6	6
Sheep	26	1,179	1,205	Other animals	-------	201	201
Goats	4	3,151	3,155				
Horses	540	1,222	1,762	Total	712	28,976	29,688

[1] Domestic fowls numbering 2,676 were inspected to meet requirements of receiving governments.
[2] Of this number 18,673 were destined to Mexico and 1 to Japan. The remaining 192 head were shipped to Central America and the West Indies.

DIVISION OF HOG-CHOLERA CONTROL

Under the supervision of U. G. Houck, chief, approximately 32 veterinarians continued their efforts in the investigation and suppression of outbreaks of hog cholera and allied swine diseases.

The work was conducted in 28 States. During the year Bureau veterinarians made 28,897 visits to farms and other premises, 7,566 in response to calls for assistance and 21,328 voluntarily to survey conditions as they pertained to hog cholera and other swine diseases. In order to arrive at positive diagnoses, 3,226 autopsies were held.

Bureau veterinarians attended 552 meetings of educational character, 355 of which they addressed. There was a total attendance at these meetings of more than 32,000 persons interested in hog-cholera control. Demonstrations in the use of the preventive serum treatment numbered 1,829 in the course of which 37,523 hogs were treated.

The number of outbreaks of hog cholera reported to Bureau veterinarians from all sources during the year was 4,358, compared with a total of 6,480 outbreaks reported the previous year. Table 3 summarizes the activities of the year.

TABLE 3.—*Summary of hog-cholera-control work, fiscal year 1933*

State	Bureau veterinarians engaged in work [1]	Meetings addressed	Premises investigated	Demonstrations		Autopsies performed	Outbreaks reported to Bureau veterinarians
				Number	Hogs treated		
Alabama	1	8	946	33	168	13	3
Colorado	.5	2	88			29	19
Florida	1	5	1,160	549	11,073	26	50
Georgia	1		2,013	3	94	7	48
Idaho	.15		45			14	53
Illinois	3	66	2,057	7	219	903	791
Indiana	2	7	1,572			199	208
Iowa	2.5	14	908	16	1,538	401	689
Kansas	.7	10	608			9	29
Kentucky	2	9	2,296	10	721	217	146
Louisiana	1		447	143	1,782	20	50
Maryland	2	38	3,503	18	516	173	267
Michigan	1.5		725	15	1,363	54	273
Mississippi	1	11	1,296	25	387	22	9
Missouri	1	11	659	63	4,515	189	132
Nebraska	1	16	630	13	858	218	125
North Carolina	1	9	742	12	2,129	79	40
Ohio	1.5	20	710	15	1,044	109	413
Oklahoma	1.5	7	2,944	7	201	73	194
Oregon	.25		129			7	10
South Carolina	1		541	450	6,140	28	58
South Dakota	1	2	335	52	2,048	90	336
Tennessee	.75	86	601	45	563	78	82
Texas	1	3	602	2	40	21	140
Virginia	1	17	2,461	295	1,352	73	25
Washington	.75	6	348	2	202	41	30
West Virginia	.15	5	261	49	411	31	56
Wisconsin	1	3	270	5	159	102	82
Total	32.25	355	28,897	1,829	37,523	3,226	4,358

[1] Fractions denote veterinarians devoting part time to the work.

MEAT INSPECTION DIVISION

The work of the Federal meat-inspection service under the direction of R. P. Steddom, chief, conducted in the usual extensive manner, shows a total of 75,322,777 animals slaughtered under inspection, a decrease of 2.4 percent under that of the preceding year.

GENERAL MEAT INSPECTION

Inspection was conducted at 770 establishments located in 262 cities and towns, as compared with 799 establishments in 269 cities and towns during the fiscal year 1932. Inspection was inaugurated at 25 establishments and withdrawn from 28, as compared with 38 and 54, respectively, during the preceding year. Inspection was withdrawn from 26 establishments on account of discontinuance of slaughtering or interstate business, and from 2 establishments for violation of the regulations. At the close of June 30, 1933, there were 742 establishments in 255 cities and towns operating under inspection.

ANTE-MORTEM AND POST-MORTEM INSPECTIONS

The results of the ante-mortem and post-morterm inspections are given in tables 4 to 7, inclusive. Tables 5, 6, and 7 show the diseases and number of condemnations on ante-mortem and post-mortem inspections.

TABLE 4.—*Ante-mortem and post-mortem inspection of animals, fiscal year 1933*

Kind	Ante-mortem inspection				Post-mortem inspection		
	Passed	Suspected [1]	Condemned [2]	Total	Passed	Condemned	Total
Cattle	7,501,350	234,869	2,564	7,738,783	7,681,560	54,028	7,735,588
Calves	4,529,384	6,551	2,431	4,538,366	4,535,504	12,452	4,547,956
Sheep and lambs	17,275,052	3,708	7,704	17,286,464	17,267,199	16,676	17,283,875
Goats	6,925	7	17	6,949	6,925	7	6,932
Swine	45,586,069	109,230	20,792	45,716,091	45,565,436	132,617	45,698,053
Horses	50,357	16	77	50,450	50,124	249	50,373
Total	74,949,137	354,381	33,585	75,337,103	75,106,748	216,029	75,322,777

[1] "Suspected" is used to designate animals suspected of being affected with disease or condition that may cause condemnation in whole or in part on special post-mortem inspection.
[2] For additional condemnations see tables 5 to 7, inclusive.

TABLE 5.—*Number of animals condemned for various diseases and conditions on ante-mortem inspection, fiscal year 1933*

Cause of condemnation	Cattle	Calves	Sheep and lambs	Goats	Swine	Horses
Actinomycosis	3					
Arthritis and other bone diseases		3			209	
Emaciation	23	21	1		4	
Gangrene	1					
Hog cholera					2,265	
Immaturity		368				
Influenza					35	
Injuries	1	12			4	
Moribund	2,420	1,957	7,671	17	16,842	76
Necrobacillosis					2	
Omphalophlebitis		1				
Parturient paresis	1					
Pneumonia, enteritis, peritonitis, etc	16	46	14		171	
Pyrexia	9	3	16		652	
Septicemia and pyemia	10	2	2		473	
Strangles						1
Toxemia	2				1	
Tumors, carcinomata, sarcomata, abscesses, etc	78				134	
Total	2,564	2,431	7,704	17	20,792	77

TABLE 6.—*Number of animals condemned for various diseases and conditions on post-mortem inspection, fiscal year 1933*

Cause of condemnation	Cattle	Calves	Sheep and lambs	Goats	Swine	Horses
Actinomycosis	666	39			2	
Anaplasmosis	17	2				
Anthrax					184	
Arthritis and other bone diseases	179	330	480		9,183	1
Asphyxia		2	32		555	2
Blackleg	15	8				
Caseous lymphadenitis			1,276	1		
Cellulitis					18	
Contamination	2	3	2		1,084	
Cysticercosis	125	13	304		20	
Dropsical diseases	42	2	61		48	
Emaciation	6,529	1,897	2,447	3	310	22
Fistula						2
Gangrene	8	1			4	
Hog cholera					21,420	
Hydronephrosis			1		26	

TABLE 6.—*Number of animals condemned for various diseases and conditions on post-mortem inspection, fiscal year 1933*—Continued

Cause of condemnation	Cattle	Calves	Sheep and lambs	Goats	Swine	Horses
Icterus	91	334	1,520		5,185	1
Immaturity		4,991				
Influenza					30	
Injuries	1,759	387	718		1,766	10
Melanosis	38	55	86		134	94
Moribund	2	5	7		34	
Necrobacillosis	8		8		4	
Necrosis	4		4		5	
Omphalophlebitis		152				
Parasitic diseases	11	1	16		38	
Pneumonia, pleurisy, enteritis, peritonitis, etc	12,311	2,850	6,961	2	26,963	75
Pregnancy and recent parturition	44		4		100	1
Pseudo-leukemia	855	36	6		229	
Septicemia and pyemia	5,682	933	1,974		24,996	18
Sexual odor				1	3,784	
Skin diseases	1				36	
Splenetic fever	1					
Strangles						5
Toxemia	5	12	2		18	
Tuberculosis	21,773	357	2		35,680	
Tumors, carcinomata, sarcomata, etc	3,749	40	52		646	18
Uremia	101	2	713		115	
Xanthosis	10					
Total	54,028	12,452	16,676	7	132,617	249

TABLE 7.—*Number of parts of carcasses,*[1] *of animals indicated, condemned for various diseases, and conditions on post-mortem inspection, fiscal year 1933*

Cause of condemnation	Parts of carcasses of—				
	Cattle	Calves	Sheep and lambs	Swine	Horses
Actinomycosis	100,909	2,563		3	
Arthritis and other bone diseases	13	7	4	85	
Caseous lymphadenitis			1		
Cellulitis	1	4		472	
Contamination	131	193	13	2,355	
Injuries	1,002	186	129	45,658	31
Melanosis	18	14		3	3
Necrobacillosis	2				
Necrosis	104		2		3
Tuberculosis	30,375	417		290,744	
Tumors and abscesses	8,834	4,565	112	468,825	212
Total	141,389	7,949	261	808,145	249

[1] In addition to these parts, 633,834 cattle livers and 30,571 calf livers were condemned on post-mortem inspection.

INSPECTION OF MEAT AND PRODUCTS

The inspection and supervision of meats and products prepared and processed are shown in table 8, which is a record only of inspection performed and not a statement of the actual quantity prepared. The record of inspection is sometimes duplicated when the product is reinspected during the different stages of preparation. Market inspection to facilitate interstate delivery of meats and products was conducted in 13 cities.

TABLE 8.—*Meat and meat-food products prepared and processed under supervision, fiscal year 1933* [1]

Product	Inspection pounds [2]	Product	Inspection pounds [2]
Cured:		Lard stearin	612,392
Beef	104,337,737	Compound and other substitutes for lard	322,145,770
Pork	2,782,341,182	Oleo stock and edible tallow	69,728,139
All other	1,240,907	Oleo oil	70,707,317
Sausage	670,497,071	Oleo stearin	34,201,846
Canned:		Oleomargarine	74,545,258
Beef	158,547,753	Miscellaneous	1,968,308,270
Pork	88,885,941	Horse meat:	
All other	4,510,874	Cured	3,129,947
Product passed for cooking:		Chopped	1,992,415
Beef	2,690,409	Canned	29,610,381
Pork	4,774,372	Oil	391,500
All other	3,978	Horse meat and mutton chopped	285,300
Pork to be eaten uncooked	74,568,252	Horse meat and mutton canned	78,822
Meat extract	96,131		
Lard	1,787,966,569		
Lard oil	838,795	Total	8,257,037,328

[1] The following quantities of meat and meat-food products were condemned on reinspection and destroyed for food purposes on account of having become sour, tainted, unclean, rancid, or otherwise unwholesome: Beef, 1,128,308 pounds; pork, 3,934,793 pounds; mutton and lamb, 43,116 pounds; veal, 22,210 pounds; goat meat, 23 pounds; horse meat, 19,217 pounds; total, 5,147,667 pounds.

[2] This term represents the total volume of inspection. The figures do not represent actual production as the same product may have been inspected and recorded more than once in the process of manufacture.

MEATS AND PRODUCTS CERTIFIED FOR EXPORT

During the fiscal year a total of 47,471 official meat-inspection certificates were issued to cover the exportation of the following products: Beef and beef products, 79,408,398 pounds; mutton and lamb and their products, 2,702,124 pounds; pork and pork products, 688,945,392 pounds; horse meat and horse-meat products, 3,263,640 pounds; total, 774,319,554 pounds. There were also issued 4,308 certificates covering the exportation of 38,958,237 pounds of inedible animal products.

EXEMPTION FROM INSPECTION

The provisions of the Meat Inspection Law requiring inspection usually do not apply to animals slaughtered by a farmer on the farm or to retail butchers and dealers supplying their customers. The retail butchers and dealers, however, in order to ship meat and meat food products in interstate or foreign commerce are required to obtain certificates of exemption. The number of such certificates outstanding at the close of the year was 990.

Shipments numbering 51,018 were made by retail butchers and dealers holding certificates of exemption. The products covered are shown in table 9.

TABLE 9.—*Shipments by retail butchers and dealers under certificates of exemption, fiscal year 1933*

Product	Carcasses	Pounds	Product	Carcasses	Pounds
Cattle (1,484 quarters)	371	247,747	Cured meats		570,529
Calves	14,295	1,056,760	Lard		33,754
Sheep and lambs	1,536	46,838	Sausage		111,892
Swine	80	10,682	Miscellaneous (headcheese, suet, compound, scrapple, etc.)		39,690
Beef, fresh		2,533,185			
Veal, fresh		264,529			
Mutton and lamb, fresh		548,133	Total	16,282	5,851,140
Pork, fresh		387,401			

During the year 47,812 interstate shipments were made of meat and meat food products from animals slaughtered by farmers on the farms. The products composing these shipments are shown in table 10.

TABLE 10.—*Shipments of farm-slaughtered meat and products, fiscal year 1933*

Product	Carcasses	Pounds	Product	Carcasses	Pounds
Cattle (445 quarters)	111	45,509	Cured meats		311,914
Calves	50,458	4,370,518	Lard		7,894
Sheep and lambs	6,017	191,269	Sausage		129,567
Swine	2,460	187,998	Miscellaneous (scrapple, livers, headcheese, souse, etc.)		222,685
Beef, fresh		23,058			
Veal, fresh		77,346			
Mutton and lamb, fresh		1,915	Total	59,046	5,675,832
Pork, fresh		106,159			

INSPECTION OF IMPORTED MEAT

Table 11 shows the inspection of imported meat and meat food products.

TABLE 11.—*Imported meat and meat food products inspected and passed, fiscal year 1933*

Country of origin	Fresh and refrigerated meat		Canned and cured meat	Other meat products	Total weight
	Beef	Other classes			
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Argentina			10,738,898	359,192	11,098,090
Australia	9,788	100	900	37,820	48,608
Brazil			6,327,144	229,079	6,556,223
Canada	283,023	869,155	1,941,421	1,194,804	4,288,403
New Zealand	98,970	72,972	288	49,721	221,951
Paraguay			1,660,984	59,190	1,720,174
Uruguay			11,373,895	235,780	11,609,675
Other countries	12,729		1,211,023	479,042	1,702,794
Total	404,510	942,227	33,254,553	2,644,628	37,245,918

Table 12 shows the quantities of foreign meat and products excluded from the country because of unsoundness, presence of prohibitive preservatives, mislabeling, or other failure to comply with the regulations.

TABLE 12.—*Imported meat and meat food products condemned and refused entry, fiscal year 1933*

Product	Condemned	Refused entry
	Pounds	*Pounds*
Beef	8,792	92,947
Mutton and lamb		304
Pork	2,797	5,743
Total	11,589	98,994

IMPORTATION OF ANIMAL CASINGS

During the fiscal year animal casings from 45 foreign countries were admitted as follows: On certification, 13,156,752 pounds; on disinfection, 1,109,310 pounds; dried casings, 1,530 pounds; total, 14,267,592 pounds. Casings amounting to 22,238 pounds offered for importation were rejected and removed from the United States.

INSPECTION FOR OTHER BRANCHES OF THE GOVERNMENT

By request of other branches of the Government, reinspections of meat and meat food products were conducted as shown in table 13, to determine whether the articles remained wholesome and conformed to certain specifications.

TABLE 13.—*Inspections for other branches of the Government, fiscal year 1933*

Branch of Government	Passed	Rejected
	Pounds	*Pounds*
Navy Department	50, 268, 392	1, 641, 472
Veterans' Administration (hospitals)	4, 833, 645	241, 960
National Homes Service	3, 952, 435	72, 217
Department of Justice (Federal penitentiaries)	3, 046, 366	114, 944
Marine Corps	2, 442, 818	83, 491
Coast Guard	1, 295, 056	22, 280
Department of Interior (Bureau of Indian Affairs)	988, 290	5, 116
War Department (Army Engineering Corps)	861, 490	10, 732
Public Health Service	393, 156	4, 227
National Zoological Park	143, 285	5, 859
Panama Railroad	39, 367	----------
Shipping Board	38, 171	----------
Alaska Engineering Commission	6, 084	----------
Department of Agriculture (Forest Service)	480	----------
	68, 309, 035	2, 202, 298

MEAT-INSPECTION LABORATORIES

Analyses and examinations of meat and products were conducted in the meat-inspection laboratories situated in the several districts throughout the country.

The total number of products examined was 40,641. A total of 2,150 products were found not in accordance with the regulations. Included among these were meats and meat food products, edible fats and oils, cereals, spices, curing materials, colors, denaturing oils, water supplies, and miscellaneous articles. The principal faults were excessive added water in sausage, improper application of artificial color to sausage casings, and failure to declare added substances permitted to be used under appropriate declaration. Of the samples found at fault 381 represented products offered for use in connection with the preparation of meat and meat food products. The products were removed from the establishments or utilized in the preparation of inedible products. Of the meat and meat food products offered for importation from foreign countries, 306 consignments were found at fault. Most of these were incorrectly labeled.

Numerous samples of oleomargarine containing emulsifying agents were examined to prevent the use of such substances to reduce the proportion of fat contained in the product. All findings of pollution in water were followed by corrective action.

LABELING MEAT AND MEAT-FOOD PRODUCTS

During the year 16,617 labels and other markings for meat and meat-food products were approved, whereas 1,599 failed of approval principally because of the inclusion of false statements or designs.

Proposed labeling by establishments that would convey false impressions of quality, food content, origin, disease-preventing or curative properties, or conceal inferiority continues to require extreme vigilance and research.

PACKERS AND STOCKYARDS DIVISION

The work of the Packers and Stockyards Division was directed during the year by A. W. Miller, chief. Under the Packers and Stockyards Act the activities involved supervision over the operations and practices of packers, stockyard companies, market agencies, and dealers, and rates and charges for stockyard services. Under the livestock quarantine laws and regulations the activities included the inspection of all livestock received at public stockyards, enforcement of the 28-hour law, and cooperation with the various States in applying their laws and regulations designed to prevent the introduction of animal diseases.

FORMAL PROCEEDINGS UNDER THE PACKERS AND STOCKYARDS ACT

On July 1, 1932, 16 formal dockets were pending. During the year 29 were instituted and reopened. Final action was taken on 36 of these cases, and 9 were pending on June 30, 1933. Details of each of the formal dockets are given in a separate publication which may be had on request.

CASES IN COURT PERTAINING TO THE PACKERS AND STOCKYARDS ACT

On July 22, 1932, the United States Circuit Court of Appeals for the Eighth Circuit rendered an opinion, 59 F. (2d) 1019, in the case of *United States* v. *Donahue Bros., Inc.* This case involved a proceeding under the Packers and Stockyards Act in which Donahue Bros., Inc., a registrant at the Omaha stockyards, was ordered to cease and desist from certain unlawful practices. The respondent was found by the Secretary to have been in disobedience of this order, and suit was filed in the District Court of the United States for the District of Nebraska to recover the penalties provided for by the act for failure to comply with an order to cease and desist. The district court held that the Secretary's order was based on a regulation which was not supported by the act and was therefore invalid. The United States appealed, and the circuit court in its opinion held that the regulation and the Secretary's order were valid and that the respondent market agency had violated the order and a penalty should be imposed. The case was remanded to the district court which on February 22, 1933, entered an order giving judgment to the United States in the sum of $500 and costs.

On November 9, 1932, the District Court of the United States for the Northern District of Illinois, Eastern Division, rendered an opinion in the case of the *United States* v. *Roberts & Oake*, a packer located in Chicago. This case involved the right of the Secretary under the Packers and Stockyards Act to require packers who buy livestock at posted stockyards to furnish bonds to secure the performance of their obligations as dealers. The district court found against the Government, and an appeal was taken to the United States Circuit Court for the Seventh Circuit. That court on June 5, 1933, handed down an opinion holding that "packers" as defined in the act are not "dealers" and that the Secretary is without authority to compel packers to furnish bonds to insure payment for livestock purchased at posted stockyards. No appeal was taken from this decision.

A statutory court of three Federal judges sitting in Omaha, on application of the Union Stock Yards Co. of Omaha, issued an order temporarily restraining the enforcement of a schedule of rates prescribed on March 1, 1933, by the Secretary in Docket No. 344, a proceeding relating to the reasonableness of the rates and charges made by the stockyards company for its services. In April 1933, the Government filed its answer to the petition of the stockyards company. At the close of the year the case had not been argued.

STOCKYARDS

During the year 6 stockyards were posted as coming within the jurisdiction of the act, and 6 were released. At the close of the year the number of stockyards posted under the act was 93.

REGISTRATIONS

On June 30, 1933, there were 1,360 market agencies and 2,904 dealers registered to operate at posted stockyards. During the year 316 market agencies and 325 dealers were registered, and 351 market agencies and 367 dealers were placed on the inactive list.

RATES AND CHARGES

Orders were issued prescribing rates for market agencies at the stock Yards located at National Stockyards, Ill., and Kansas City, Mo., and a hearing was commenced as to the reasonableness of commission rates at the Union Stock Yards, Chicago, Ill.

A hearing was held as to the reasonableness of stockyard rates at the Union Stock Yards, Omaha, Nebr. An oral argument was made before the Secretary, and an order was issued prescribing reasonable rates, the enforcement of which was temporarily restrained by a Federal court. A rehearing was held with respect to the reasonableness of stockyard rates at St. Joseph, Mo., in accordance with the court decision in that case.

During the year a number of market agencies filed general revisions of their schedules substantially reducing commission charges. Substantial reductions were also made voluntarily during the year in charges for feed at many markets, and in a number of instances yardage charges were reduced on account of the general economic condition prevailing.

BONDS

Market agencies and dealers generally complied with the bond regulation. The general economic conditions have made it increasingly difficult for registrants to obtain satisfactory bond coverage. Where bonds were not furnished and informal action failed, formal proceedings were instituted to effect compliance with the regulation.

TRADE PRACTICES

Supervisors made numerous investigations and reports on general marketing conditions and also assisted in the revision of tariffs and regulations of market agencies and stockyard companies. A large number of complaints were received and carefully investigated by the supervisors and special investigators in the field. Several of the complaints involved alleged price discrimination in the purchase of poultry and dairy products by packers. Hearings were held in several cases involving alleged payments by commission firms to commercial truckers of livestock in order to induce the truckers to deliver the livestock to the firms making the payments. This was held to be an unfair practice and a number of respondents were ordered to cease and desist from engaging in it. In addition to these activities, a number of trade-practice audits were made at various markets which in a few cases revealed conditions that warranted the institution of formal proceedings.

SCALES AND WEIGHING

Bureau weight supervisors continued their visits during the year to posted stockyards for the purpose of inspecting scales, supervising tests, and checking the weighing operations generally. In those instances where scales were found to be defective or weighing out of tolerance, the necessary repairs and corrections were made so that the scales were left in a satisfactory weighing condition. Stockyard companies generally continued to manifest interest in this work and cooperated with the Bureau in it.

AUDITS AND ACCOUNTS

During the year accountants of the Bureau made audits of the books and records of 62 market agencies at the Kansas City stockyards, 124 at Chicago, and 16 at Denver in preparation for commission rate hearings at those three places. In addition, detailed audits of the stockyard companies at Sioux City and St. Joseph were brought up to date preparatory for hearings on their rates, and approximately 100 trade-practice and balance-sheet audits were made of the books and records of market agencies and dealers at various markets.

SUMMARIES OF REPORTS

Information compiled from the annual reports received from packers, stockyard companies, market agencies, and dealers is shown in tables 14 to 19, inclusive. The various reports cover business during the calendar year, with a few exceptions, which are on the basis of the fiscal year.

TABLE 14.—*Financial results of operations during 1932 for 868 packers subject to the Packers and Stockyards Act, grouped according to federally and nonfederally inspected slaughtering and nonslaughtering concerns*

Group	Concerns	Average net worth [1]	Net sales	Net loss
	Number	*Dollars*	*Dollars*	*Dollars*
Federally inspected slaughterers	211	730,088,723	1,798,710,146	5,561,932
Nonfederally inspected slaughterers	415	50,947,016	161,853,528	895,028
Nonslaughterers [2]	242	160,011,243	226,335,644	1,429,874
Total	868	941,046,982	2,186,899,318	7,886,834

[1] These figures represent the numerical average of the total net worth of reporting concerns at the beginning and end of their fiscal years.

[2] This group includes concerns which also handle commodities other than meat food products.

In addition to the complete reports from 868 packing concerns, financial details, lacking in some respects, were received from 20 other packers for the year 1932.

TABLE 15.—*Comparison of the operations of packers subject to the Packers and Stockyards Act, 1928–32*

Item	1928 (680 concerns)	1929 (832 concerns)	1930 (945 concerns)	1931 (927 concerns)	1932 (868 concerns)
Average net worth [1]	$983, 705, 930	$1, 019, 980, 098	$1, 058, 940, 521	$1, 057, 166, 076	$941, 046, 982
Total income	4, 110, 095, 060	4, 308, 814, 715	4, 023, 493, 741	3, 070, 743, 390	2, 204, 146, 322
Total expenses	4, 039, 890, 813	4, 243, 073, 083	3, 973, 497, 594	3, 083, 939, 372	2, 212, 033, 156
Net gain	70, 204, 247	65, 741, 632	49, 996, 147	[2] 13, 195, 982	[2] 7, 886, 834
Percentage of gain to net worth	7. 14	6. 45	4. 72	[2] 1. 25	[2] 0. 84

[1] These figures represent the average of the total net worth of all reporting concerns at the beginning and end of their fiscal years.
[2] Loss.

TABLE 16.—*Summary of consolidated balance sheets of 80 posted stockyards at close of year 1932* [1]

Assets	Amount	Liabilities	Amount
Current	$8, 544, 981	Current	$3, 245, 044
Fixed	138, 649, 956	Other	37, 553, 308
Other	13, 861, 159	Capital and surplus	120, 257, 744
Total	161, 056, 096	Total	161, 056, 096

[1] 5 yards deposted. Reports from 3 yards not requested, reports from 6 yards waived, 7 yards posted too late for tabulation, and reports from 2 yards not received for year 1932.

A summary of consolidated profit and loss statements of 80 posted stockyards for the year 1932 [1] follows:

Income:	
Yardage	$10, 617, 965
Feed sales	5, 945 986
Loading and unloading	1, 199, 300
Rent	1, 954, 963
Miscellaneous operations	3, 367, 249
Gross operating income	23, 085, 463
Expenses:	
Salaries and wages	5, 649, 565
Cost of sales—feed	2, 555, 697
Depreciation	2, 104, 035
Taxes (excluding Federal income tax)	1, 337, 467
Miscellaneous operating expenses	6, 004, 253
Total operating expenses	17, 651, 017
Net operating profit	5, 434 446
Other income	727, 046
Total	6, 161, 492
Deductions from income	1, 597, 982
Net profit	4, 563, 510

TABLE 17.—*Summary of reports from stockyard companies subject to the Packers and Stockyards Act, 1928–32*

Item	1928 (67 concerns)	1929 (69 concerns)	1930 (70 concerns)	1931 (67 concerns)	1932 (80 concerns)
Total average net worth	$119, 274, 997	$120, 360, 158	$122, 258, 111	$120, 874, 011	$120, 391, 889
Gross income	31, 355, 620	30, 157, 389	30, 646, 729	27, 791, 967	23, 812, 509
Net gain	7, 533, 519	7, 114, 989	7, 069, 624	6, 584, 478	4, 563, 510
Percentage of gain to net worth	6. 32	5. 91	5. 78	5. 45	3. 79

[1] 5 yards deposted. Reports from 3 yards not requested, reports from 6 yards waived, 7 yards posted too late for tabulation, and reports from 2 yards not received for year 1932.

LIVESTOCK COMMISSION AGENCIES

Number and class of market agencies reporting in 1932 follow:

Old-line agencies	665
Cooperative agencies	38
Horse and mule agencies	10
Total	713

TABLE 18.—*Summary of consolidated operating statements of livestock commission agencies, 1930–32*

Item	1930 (727 agencies)	1931 (680 agencies)	1932 (713 agencies)
Total commissions earned	$21,412,613	$20,699,222	$18,460,190
Total expenses (exclusive of owners' salaries)	15,768,195	15,221,131	14,114,122
Net operating profit	5,644,418	5,478,091	4,346,068
Other income	900,784	749,557	747,082
Other expenses	23,586	15,512	10,222
Return to owners	6,521,616	6,212,136	5,082,928

TABLE 19.—*Summary of consolidated profit and loss statements of 793 traders on 40 markets for 1932* [1]

Item	Dockage [2]	Animals handled	Weight	Amount
Cattle:				
603 traders on 40 markets:	*Pounds*	*Number*	*Pounds*	
Selling data		3,275,638	1,803,938,506	$87,964,992
Cost data		3,275,882	1,794,940,420	84,196,125
Sheep:				
74 traders on 28 markets:				
Selling data		1,624,496	103,986,982	5,849,300
Cost data		1,625,020	105,200,004	5,539,816
Horses and mules:				
14 traders on 5 markets:				
Selling data		16,278		1,226,458
Cost data		16,277		1,103,289
Hogs:				
181 traders on 32 markets:				
Selling data	2,045,968	4,465,280	968,023,950	34,650,398
Cost data	2,266,217	4,465,735	965,807,386	33,822,275
All species:				
793 traders on 40 markets:				
Selling price				129,691,148
Cost price				124,661,505
Gross trading profit				5,029,643
Clearance commissions received				29,812
Other income				159,718
Total earnings				5,219,173
Expenses:				
Salaries and wages (other than owners)				948,295
Clearance commissions paid				447,320
Feed				1,053,660
Yardage				245,531
Other expenses				925,790
Total				3,620,596
Return to owners				1,598,577

[1] Does not include traders who were engaged also in order-buying business. Some of the traders handled more than one species.

[2] Represents deduction in weight at time of sale because of quality or condition of the animal. This practice applies only to hogs.

CONTROL OF INTERSTATE TRANSPORTATION OF LIVESTOCK

In the supervision of the interstate transportation of livestock to prevent the spread of animal diseases, Bureau employees at market centers inspected 15,753,800 cattle and 25,910,912 sheep, of which 1,742 cattle and 199,796 sheep were dipped under supervision to comply with the regulations of the Department

and the various States to which they were destined. The number of swine inspected was 31,038,336, of which 167,403 were immunized and disinfected against hog cholera under Bureau supervision for distribution for feeding and breeding purposes.

Railroad stockyards where livestock in transit are fed, watered, and rested, and divisions of public stockyards in which feeder and stocker cattle are handled were cleaned and disinfected under Bureau supervision in an effort to reduce losses among these classes of cattle on account of hemorrhagic septicemia.

There were received at Bureau stations during the year, 7,096 cars carrying animals affected with communicable diseases. Under Department regulations or on request of Canadian Government, State, and railroad officials, 12,208 cars were cleaned and disinfected under the supervision of Bureau employees.

The practice of having experienced veterinary inspectors at public stockyards give particular attention to the inspection of all ruminants and swine for foot-and-mouth disease was continued.

ENFORCEMENT OF TRANSPORTATION AND QUARANTINE LAWS

The railroads continued to make improvements in the facilities at stockyards at which livestock in transit are unloaded for feed, water, and rest in compliance with the provisions of the 28-hour law. The Bureau reported 139 apparent violations to the Solicitor for presentation to the Attorney General. Penalties amounting to $13,300 were imposed in cases decided in favor of the Government. With the exception of four employees who devoted most of their time to this work, the evidence was collected and reports prepared largely by employees stationed at public stockyards who are regularly assigned to other lines of work.

In the enforcement of the animal quarantine laws and regulations there were reported for prosecution 29 cases of alleged violations, and in the cases decided in favor of the Government, fines imposed amounted to $2,000.

PATHOLOGICAL DIVISION

Under the direction of Harry W. Schoening, chief, the Pathological Division has followed its usual line of scientific investigation of the diseases of domestic animals and birds, the poisoning of livestock by plants, and the examination of viruses, serums, and other biological products used in the treatment or prevention of diseases of domestic animals.

DIAGNOSIS AND CONTROL OF DISEASES

Cooperative work for the control and eradication of glanders in the various States was continued. The complement-fixation test was applied to 221 samples of blood serum from animals suspected of being affected with or exposed to the disease, 27 of which gave positive reactions.

Samples of blood serum from 1,032 horses in districts where dourine is present or suspected were subjected to the complement-fixation test, and 7 gave positive reactions.

Blood serum samples from 17 camels, horses, donkeys, and other animals offered for import were subjected to the complement-fixation test for glanders and trypanosomiasis before the animals were admitted. No positive reactions were obtained.

Sixty-five suspected cases of rabies were received and subjected to laboratory examination. Of these, 54 were from dogs, of which 4 were positive, 3 of the animals being from Maryland and 1 from West Virginia. Of 6 cats, 1 horse, 2 rats, 1 squirrel, and 1 cow, only the cow was found to be positive. That animal was from West Virginia. No positive cases were diagnosed in animals from the District of Columbia.

During the year several hundred poultry specimens were received for examination. Post-mortem and bacteriological examinations revealed many of the usual affections of poultry, including pullorum disease in baby chicks and adult birds. roup, chicken pox (diphtheria), infectious bronchitis, fowl cholera, fowl typhoid, lymphomatosis, tuberculosis, salpingitis, leucosis, pneumonia, tumors, and other abnormal conditions. An outbreak of leucosis in a large flock in which the mortality reached 25 percent afforded some excellent material for study. Enlargement and mottling of the liver and spleen, together with high leucocyte count and negative bacteriological findings, were the predominant characteristics of this disease.

RESEARCH ON DISEASES

Investigation of bovine mastitis was continued during the year. Principal attention was given to the methods for diagnosing the disease. These are the chlorine, the catalase, and the brom-thymol blue tests, the Breed count of tissue cells, palpation of the udder, use of the strip cup, and bacteriological examination of the milk from the individual quarters of the udder. A description of these methods was published. From the results obtained it appears that chronic or sublatent mastitis can be readily detected by the use of a combination of any two or three of these methods with the exception of the strip cup, which has not proved to be of much value as a diagnostic aid. The causative agent of the mastitis, however, can be ascertained only by bacteriological examination of the milk. The bacteria which have been definitely identified as causing mastitis are streptococci and micrococci. The use of bacterins in large doses alone or in combination with sterile milk, administered intradermically, subcutaneously, and intramuscularly, has not been observed to be of benefit.

In the continued study of tuberculosis, specimens of tuberculous lymph glands from hogs fed mixed garbage collected from homes, restaurants, hotels, markets, and sanitariums were submitted for typing. Examination of these specimens revealed the presence of organisms having the characteristics of the human type of tubercle bacillus in material from one hog, whereas those from another hog revealed organisms having the characteristics of the avian type of tubercle bacillus. Specimens of tuberculous lesions collected from reactor cattle belonging to a State hospital herd, in which the presence of human tuberculosis was suspected owing to hospital inmates handling cattle, were submitted for typing. Examination of these specimens revealed the presence of a bovine type of tubercle bacillus.

Experimental studies in the transmission of swine erysipelas have been completed. Of 22 pigs subjected to the different methods of exposure, definite symptoms of swine erysipelas were observed in 11 pigs, 5 cases being fatal. Four of the six nonfatal cases showed lesions of arthritis. This finding is in accord with field observations and laboratory examinations, which have indicated that arthritis is one of the common sequels of erysipelas infection in pigs. Studies have continued with respect to the preparation of swine-erysipelas antigen and the improvement of the technic of the agglutination test. Serological studies have been made of a number of artificially infected pigs for the purpose of determining the time required for the formation of agglutinins in the blood of pigs after infection has taken place, or after the first symptoms have appeared. Results of these studies show definite agglutination reactions in the blood of infected pigs on the sixth day after inoculation, which is on the average about the third day after the first definite symptoms are noted. These findings are also in agreement with observations and tests made in acute cases of swine erysipelas in the field.

This year's work included also the study of brucellosis and swine-erysipelas lesions of the vertebral bones of swine.

Lesions of the vertebral bones of swine caused by *Brucella suis* were first recognized and studied by the Bureau in 1930. Since then many specimens have been examined and the lesions found to consist of local areas of necrosis varying in diameter from a few millimeters to several centimeters and nearly always involving the body of the vertebra. During the past year specimens of swine vertebrae showing a different type of lesion were studied. In these, the pathological process consisted largely of osteophytic proliferations extending outward from the ventral surface of the bone with some softening of the center of the lesions but no gross necrosis. Besides the vertebral lesions, a polyarthritis involving several of the joints of the limbs existed in all cases and the swine-erysipelas organism was isolated from all of the these vertebral lesions.

During the last 3 years infectious equine encephalomyelitis, formerly known as cerebrospinal meningitis, forage poisoning, etc., has existed in epizootic proportions in a number of the Western and Southwestern States. In 1931, three California investigators reported the isolation of a filtrable virus from the brain of a horse suffering with the disease and were able to reproduce the disease regularly with the virus. Early in the fall of 1932, the Bureau recovered a strain of virus from the brain of a typical case occurring in South Dakota where the disease was epizootic. This strain was shown to be identical with the California strain. The disease has been transmitted to guinea pigs by various methods of experimental inoculation. It was not transmitted to either horses or guinea pigs by direct exposure of normal animals to those affected or by the eating and drinking of feed and water contaminated by sick animals. The following animals

have been found to be definitely susceptible to experimental inoculation: Horse, calf, pigeon, guinea pig, white rat, white mouse, and rabbit. Sheep, chickens, cats, and dogs proved to be completely refractory to intracerebral inoculation. Guinea pigs were successfully immunized by injection of formalin-treated brains of infected guinea pigs.

Investigations of shipping fever were continued along the same general lines as in the preceding years, the principal object being to determine the value of hemorrhagic septicemia bacterin, aggressin, and antihemorrhagic septicemia serum in controlling shipping fever. A total of 1,796 cattle was used in the experiment. Of these, 1,005 were vaccinated and the remainder were controls. As happened in the preceding year, practically no shipping fever developed in either the vaccinated or unvaccinated groups of animals, which prevented an evaluation of the treatments that were given.

The virtual absence of shipping fever in the 2 years in which this investigation was under way demonstrates quite clearly the uncertainty attending an investigation of an irregularly occurring disease such as shipping fever.

In research on anaplasmosis, two splenectomized dogs proved to be completely refractory to inoculation of blood taken from a bull during an acute attack of the disease. One animal received 10 cubic centimeters of blood intravenously, the other 10 cubic centimeters subcutaneously. Sixty-six days after the inoculation 30 cubic centimeters of pooled blood from these dogs were injected into a susceptible cow without causing any febrile or parasitic reaction. It was concluded that dogs are neither susceptible to nor carriers of anaplasmosis. A minute dose (0.0025 cubic centimeter) of heavily parasitized blood failed to produce anaplasmosis either by the intradermic or subcutaneous route in cows.

Studies of nasal granuloma in cattle have been completed and the results published. The histopathological changes in this disease are essentially those of granulation tissue, the lesions varying somewhat in the different stages of the disease. This disease is very similar to, if not identical with, a disease designated as nasal granuloma prevalent in the cattle of India. The slow progress of the disease, lack of tendency to spread from animal to animal, and failure of efforts to transmit the disease by direct inoculation indicate that the causative agent is not of a bacterial nature. The negative bacteriological findings and failure to transmit the disease by experimental inoculation, together with the similarity of the clinical and pathological pictures to nasal granuloma of India which is due to parasitic infestation, point strongly to parasites as the causative agents.

INVESTIGATION OF STOCK-POISONING PLANTS

Sixteen species of plants that were known to be poisonous or suspected of being so were fed experimentally to livestock.

Green, freshly collected bitter rubber weed, *Actinea odorata*, was found to be no more toxic than the air-dried plants. Mineral oil, Epsom salt, and calomel were found to be ineffective as means of preventing poisoning.

The leaves of the tung-oil tree, *Aleurites fordii*, were shown to be poisonous for sheep.

With green timber poison vetch, *Astragalus hylophilus*, symptoms of poisoning were produced experimentally which corresponded with those that occur in animals poisoned on the range in areas where the plant grows. This plant was found to lose much of its toxicity in drying.

The tall larkspur, *Delphinium barbeyi*, was found to be more poisonous than generally considered, cattle being poisoned on as little as 0.5 percent of their own weight of fresh green leaves of young plant. Plants blighted before maturing were found to remain poisonous for cattle later in the season than those that developed normally. Contrary to former experiences, it was shown that a sheep can be poisoned experimentally by larkspur.

In the experimental study of several species of lupines, it was found that the leaves of the mature plants were much less poisonous than those from young plants. *Lupinus caudatus* was less toxic for horses than for cattle. Small feedings of *L. leucophyllus*, a species that poisons sheep, did not definitely affect cattle or horses.

Senecio longilobus was shown to be associated with serious cattle losses in the Southwest, and *S. spartioides* was shown to be toxic for cattle.

The buds and blooms of bear grass, *Nolina texana*, were found to be one of the causes of swellhead in sheep and goats, and animals kept in bright sunlight were found to be more readily affected that those that were protected from the light. The principal lesions were in the liver and kidney.

Psilostrophe gnaphalodes and *P. tagetinae*, two species heretofore often regarded as good feed, were shown to be poisonous for sheep and goats and to be responsible for the illness and death of many animals.

TOXICOLOGICAL INVESTIGATIONS

Chemical studies were made on seven species of lupines. A study of the variation in alkaloidal content of *Lupinus palmeri* and *L. barbiger* specimens collected in different localities and at different stages of growth showed that the young plants contain considerably more alkaloid than older plants and may be expected to be more poisonous to livestock. Two new alkaloids were discovered in *L. palmeri*, two in *L. barbiger*, and one in each of the following species: *L. caudatus*, *L. rivularis*, and *L. andersonii*. Toxicological studies of bitter rubber weed, scabbed barley, and two varieties of larkspurs were conducted, but results are yet inconclusive.

TESTING BIOLOGICAL PRODUCTS

In cooperation with the Division of Virus-Serum Control in the enforcement of the Virus Serum Toxin Act, the Pathological Division continued to examine representative biologics and cultures prepared under United States veterinary licenses.

During the year 58 samples of serums, vaccines, bacterins, aggressins, filtrates, toxoids, and antitoxins were examined for purity, potency, and safety. Of these, 49 were approved and 9 were disapproved. Cultures numbering 218 were examined, of which 186 were found to be true to type, whereas 32 proved to be unsatisfactory for use in the preparation of biologics.

BRANCH LABORATORIES

BELTSVILLE

During the year 2,712 birds from the Department poultry farm and 76 fowls from outside sources were necropsied at the branch laboratory, Beltsville, Md. An outbreak of an infectious disease in the guinea pigs of the genetics laboratory was studied and found to be due to a micro-organism of the paratyphoid group resembling in cultural characters *Salmonella anatum*. A disease commonly known as "crazy chick", which is characterized by symptoms of encephalitis, assumed enzootic proportions in the chicks of two of the brooder houses in which "leg weakness" experiments are conducted. Calcium gluconate treatment gave promising results.

BETHESDA

The branch pathological laboratory at Bethesda, Md., engaged in diversified investigations on poultry diseases. In connection with field investigations at New York City, 157 cases of infectious laryngotracheitis were autopsied and examined bacteriologically. Fourteen yielded cultures of the fowl-cholera bacillus, eight of which were verified serologically. Field investigations in Massachusetts demonstrated the feasibility of controlling infectious laryngotracheitis by strict hygienic measures under certain epizootiological conditions. A geographical survey conducted during the year indicated a continent-wide distribution of infectious laryngotracheitis with varying degrees of severity.

In an investigation of pullorum disease, a number of field tests were made comparing the rapid whole-blood test (stained antigen) with the pullorin (wattle) test and checking the results in each flock tested by means of autopsy and bacteriological examination of reactors. The former test was found to be the more accurate.

The laboratory cooperated with the Rhode Island State College in the diagnosis and study of a new respiratory disease of chickens and pheasants, to which the name "infectious rhinitis" was given. The disease has since been recognized in pathological specimens of chickens from two counties in Maryland, and in chickens and pheasants from one locality in Wisconsin.

A number of feeding tests of seed oats which had been treated chemically for smut indicated that horses fed ordinary quantities of such oats over an indefinite period of time did not suffer any detriment from such feeding.

CHICAGO

The branch pathological laboratory at Chicago, Ill., was engaged, as previously, in investigating diseases of meat food animals. The principal function of this laboratory is to aid the Federal meat-inspection service. The specimens received for diagnosis represent a large variety of diseases and conditions which

are encountered by Federal inspectors. In one instance the causative organism of erysipelas in swine was found in the kidney of a hog from Birmingham, Ala. This case is of interest because erysipelas in swine has been mostly confined to the Corn Belt. The lesions in the skin were typical of acute erysipelas. Of a number of vertebral abscesses in swine, about 40 percent were found to contain *Brucella suis*.

DENVER

During the year 4,234 specimens from various kinds of mammals and birds, as well as miscellaneous products, were received for examination in the laboratory at Denver, Colo. In birds the major diseases encountered were pullorum disease, paralyses of all types, and coccidiosis. In cattle, abortion disease, anthrax, and blackleg were the most common affections diagnosed. In swine 215 positive cases of erysipelas were diagnosed. During the fall of 1932, a positive diagnosis of anaplasmosis was made in three cattle in northwestern Colorado. It is probable that anaplasmosis has existed in restricted areas of Colorado for a number of years.

TICK-ERADICATION DIVISION

The eradication of the cattle tick which transmits splenetic, southern, or tick fever was continued, in cooperation with southern cattle owners and State and county officials, under the direction of W. M. MacKellar, chief.

At the close of the fiscal year 391 veterinarians and other Bureau employees were working in cooperation with 338 State and 86 county employees engaged in this project. Under their supervision 25,328,261 inspections or dippings of cattle and 2,368,581 inspections or dippings of horses and mules were conducted. More than 10,000 dipping vats were used in the official dippings.

RESULTS OF THE YEAR'S ACTIVITIES

The following areas were released from Federal quarantine as a result of tick-eradication activities: 7 counties and the remainder of 1 county in Arkansas; 6 counties, the remainder of 1 county, and parts of 2 counties in Florida; and 10 counties and the remainder of 1 county in Texas. The aggregate area of this released territory is 20,290 square miles. No areas were requarantined during the year.

The release of the Arkansas territory made it the twelfth State to gain freedom from the tick quarantine. The recently enacted Louisiana tick-eradication revenue law became effective early in the fiscal year. With the funds thus provided, that State, after being inactive several years, undertook systematic tick eradication in three parishes.

At the close of the fiscal year the area remaining under Federal quarantine in continental United States had been reduced to 12 percent of its original size and is now confined to parts of Florida, Louisiana, and Texas.

Table 20 shows the progress in tick eradication since its beginning in 1906 and gives its status at the close of the fiscal year.

TABLE 20.—*Tick-eradication results July 1, 1906, to June 30, 1933*

State	Counties quarantined on—		Counties released to June 30, 1933	Released counties tick free on Nov. 1—			
	July 1, 1906	June 30, 1933		1929	1930	1931	1932
Alabama	67	0	67	63	64	67	67
Arkansas	75	0	75	45	53	55	60
California	15	0	15	15	15	15	15
Florida	67	18	49	30	33	41	46
Georgia	158	0	158	155	158	158	157
Kentucky	2	0	2	2	2	2	2
Louisiana	64	42	22	3	10	17	10
Mississippi	82	0	82	55	78	77	77
Missouri	4	0	4	4	4	4	4
North Carolina	73	0	73	73	70	73	73
Oklahoma	61	0	61	60	61	61	61
South Carolina	46	0	46	46	46	46	46
Tennessee	42	0	42	42	42	42	42
Texas	198	41	157	94	116	113	126
Virginia	31	0	31	30	31	30	31
Total	985	101	884	717	783	801	817

AUSTRALIAN VARIETY OF FEVER TICK

During the year large numbers of ticks were collected from the various infested areas and submitted to the Zoological Division for classification. From the information thus obtained it appears that the cattle-fever ticks now generally found in the infested area of the State of Florida are of the Australian variety, *Boophilus annulatus*, var. *australis*. This tropical variety of fever tick is believed to have a wider host range than the North American fever tick, *B. annulatus*, which was common to most of the infested areas of the United States. Because of the ability of the Australian variety of tick to complete its life cycle on one and possibly more wild animals besides its domestic hosts, its eradication may involve the new problem of controlling some of the game animals in the eradication areas. During the year a few cases of reinfestation in tick-free areas, apparently due to the presence of numerous deer and this variety of tick, were reported.

MOVEMENT FROM QUARANTINED AREAS

In the enforcement of Department regulations governing the interstate movement of cattle and horses from the areas quarantined for splenetic, southern, or tick fever, 144,166 cattle were inspected, or dipped and inspected, for which 2,195 certificates were issued authorizing their interstate movement as noninfectious. Horses and mules to the number of 4,570 were also inspected in the quarantined areas and 487 certificates were issued authorizing their movement from such areas. In connection with these movements 1,317 cars were cleaned and disinfected.

TUBERCULOSIS-ERADICATION DIVISION

The work of tuberculosis eradication in cooperation with the various States, counties, and livestock owners made substantial progress during the year. This work on the part of the Bureau was directed by A. E. Wight, chief of the division.

The year's activities consisted largely in the tuberculin testing of cattle under the area plan. Altogether, 13,073,894 cattle were tested. The percentage of reactors was 2.0, whereas for the fiscal year 1932 it was 1.9. This increase is a result of the extensive area work carried on, involving the tuberculin testing of large numbers of cattle in highly infected areas in some of the Eastern States.

The Bureau's force engaged in tuberculosis eradication averaged 197 veterinarians who were under the supervision of inspectors in charge of 44 field stations. The respective States had under the jurisdiction of their livestock officials an average of 376 veterinarians, a small number of whom were employed by municipalities. In addition, counties cooperating with the officials of the States and the Bureau employed an average of 210 veterinary inspectors on full time. Thus, 783 veterinarians were engaged in the work regularly throughout the year, which is a decrease of approximately 103 full-time employees as compared with the preceding year.

The Federal appropriation for the work was $6,061,777, of which $1,221,777 was allotted for operating expenses and $4,840,000 for paying indemnity to owners for cattle condemned as a result of the test. The combined State and county appropriations amounted to about $13,000,000.

Results of tests of cattle with either johnin or avian tuberculin for the detection of paratuberculosis showed the disease to exist in a slight degree in 12 States. Altogether, 225 cattle were condemned on account of the disease, the number being approximately 8 percent of the total number examined.

PROGRESS IN TUBERCULIN TESTING OF CATTLE

The total numbers of herds and cattle under supervision at the end of the year were 3,926,645 and 35,736,707, respectively. Thirty-two States and the District of Columbia reported that more than 50 percent of their cattle are under supervision for the eradication of tuberculosis. As an indication of the continued interest in the work throughout the United States, there was at the end of the year a waiting list of more than 2,087,328 cattle.

Table 21 shows that from the fiscal year 1917 to 1933, inclusive, 2,693,570 reactors have been removed from the cattle herds of the Nation. This has been done without creating serious economic disturbance or any shortage of the necessary milk supply.

TABLE 21.—*Progress of tuberculin testing under accredited-herd and area plans 1917–33*

Year ended June 30—	Cattle tested					Modified accredited counties	Herds accredited [1]	Herds passed one test [1]	Herds under supervision [1]
	Accredited herd plan	Area plan	Total	Reactors found and removed					
	Number	*Number*	*Number*	*Number*	*Percent*	*Number*	*Number*	*Number*	*Number*
1917	20,101		20,101	645	3.2				
1918	134,143		134,143	6,544	4.9		204	883	
1919	329,878		329,878	13,528	4.1		578	5,652	
1920	700,670		700,670	28,709	4.1		2,588	10,064	
1921	1,366,358		1,366,358	53,768	3.9		4,831	33,215	71,806
1922	1,722,209	[2] 662,027	2,384,236	82,569	3.5		8,015	111,719	140,376
1923	1,695,662	1,765,187	3,460,849	113,844	3.3		12,310	150,748	187,915
1924	1,865,863	3,446,501	5,312,364	171,559	3.2	38	19,747	216,737	305,809
1925	2,008,526	4,991,502	7,000,028	214,491	3.1	51	24,110	392,740	414,620
1926	1,989,048	6,661,732	8,650,780	323,084	3.7	109	24,009	382,674	435,840
1927	2,522,791	7,177,385	9,700,176	285,361	2.9	149	34,084	229,086	261,148
1928	2,589,844	8,691,646	11,281,490	262,113	2.3	180	38,880	427,595	473,218
1929	2,853,633	8,830,087	11,683,720	206,764	1.8	213	1,639	249,420	281,323
1930	2,953,350	9,892,521	12,845,871	216,932	1.7	236	11,863	227,921	347,448
1931	3,086,403	10,695,870	13,782,273	203,778	1.5	247	[3] 26,259	350,735	356,916
1932	3,131,426	10,312,131	13,443,557	254,785	1.9	220	18,049	262,988	303,832
1933	2,980,526	10,093,368	13,073,894	255,096	2.0	183	19,701	337,730	346,394
Total	31,950,431	83,219,957	115,170,388	2,693,570	2.3	[4] 1,626	194,349	3,389,907	3,926,645

[1] The figures in these columns represent net increases at the close of each year.
[2] Testing during 6 months.
[3] Represents decrease from figures for previous year.
[4] Not including part of 1 county and 74 towns.

ERADICATION OF TUBERCULOSIS FROM AREAS

The work under the area plan of eradication has continued to grow. Approximately 77 percent of all the cattle tested during the year were tested under the area plan.

The tuberculin testing of all the cattle in Nevada, New Hampshire, and Utah was completed during the year, and these entire States were declared modified accredited areas, signifying that tuberculosis among the cattle in those States did not exceed 0.5 percent. These States make a total of 11 so classified.

At the conclusion of the year the modified accredited area included 1,626 counties, part of 1 other county, and 74 towns. This is in comparison with 1,443 counties, part of 1 other county, and 60 towns at the end of the previous fiscal year. At the end of the fiscal year 53 percent of all the counties in the United States were modified accredited areas and, including these counties, 62.5 percent of all the counties in the United States were engaged in eradicating the disease from their livestock. Table 22 shows the status of area work on June 30, 1933.

TABLE 22.—*Status of tuberculosis eradication from county areas at close of fiscal year 1933*

State	Total counties in State [1]	Counties completing 1 or more tests of all cattle [1]	Counties intensively engaged in testing	Total counties engaged [1]	Modified accredited areas [1]
Alabama	67	18	1	19	17
Arizona	14	0	2	2	0
Arkansas	75	7	1	8	7
California	58	7	19	26	6
Colorado	63	0	2	2	0
Connecticut	8	1	3	4	1
Delaware	3	1	1	2	1
District of Columbia	1	1	0	1	1
Florida	67	37	8	45	36
Georgia	161	76	7	83	74
Idaho	44	44	0	44	44
Illinois	102	91	11	102	91
Indiana	92	92	0	92	92
Iowa	99	83	16	99	78
Kansas	105	61	2	63	61

[1] Including District of Columbia.

TABLE 22.—*Status of tuberculosis eradication from county areas at close of fiscal year 1933*—Continued

State	Total counties in State	Counties completing 1 or more tests of all cattle	Counties intensively engaged in testing	Total counties engaged	Modified accredited areas
Kentucky	120	106	8	114	106
Louisiana	64	0	0	0	0
Maine	16	16	0	16	16
Maryland	23	11	7	18	5
Massachusetts	14	2	1	3	2
Michigan	83	83	0	83	83
Minnesota	87	65	0	65	64
Mississippi	82	11	1	12	10
Missouri	114	26	9	35	26
Montana	56	22	2	24	22
Nebraska	93	50	3	53	49
Nevada	17	17	0	17	17
New Hampshire	10	10	0	10	10
New Jersey	21	0	21	21	0
New Mexico	31	3	26	29	3
New York	62	32	26	58	13
North Carolina	100	100	0	100	100
North Dakota	53	53	0	53	53
Ohio	88	88	0	88	88
Oklahoma	77	9	2	11	9
Oregon	36	28	8	36	28
Pennsylvania	67	50	16	66	50
Rhode Island	5	0	0	0	0
South Carolina	46	33	3	36	33
South Dakota	69	6	0	6	3
Tennessee	95	[2] 48	[2] 4	53	[2] 48
Texas	254	14	3	17	14
Utah	29	29	0	29	29
Vermont	14	[3] 2	12	14	[3] 2
Virginia	100	76	14	90	76
Washington	39	38	1	39	37
West Virginia	55	50	5	55	50
Wisconsin	71	71	0	71	71
Wyoming	23	0	8	8	0
Total	3,073	1,668	253	1,922	[4] 1,626

[2] Not including part of 1 county.
[3] Not including 74 towns.
[4] Not including part of 1 county and 74 towns.

ERADICATION OF TUBERCULOSIS FROM SWINE AND POULTRY

The control and eradication of the avian type of tuberculosis have been a part of the regular program for the eradication of tuberculosis from livestock. During the year 15 Bureau veterinarians were assigned to this project in the more heavily infected sections, which are the Midwestern and North Central States. There, work was done in cooperation with the State livestock sanitary officials, who were able to assign a few veterinarians to the project.

The employees engaged in this activity visited 29,161 farms and inspected approximately 4,253,000 fowls, finding the disease on 9,419 farms. A considerable number of swine were found to be affected with the avian type of the disease. The owners of these infected animals were informed that swine become infected through water and feed contaminated with the droppings of tuberculous fowls. Literature was furnished the poultry owners, and invitations extended them to visit meetings where the subject was given consideration.

The survey of farm poultry flocks in connection with the testing of cattle, begun several years ago, was continued. During the year 168,286 flocks, containing approximately 15,741,500 fowls, in 21 States, were inspected. Of these flocks, 5,999 were found to be infected with tuberculosis, as indicated by cases of the disease in them. As the inspections were made by veterinarians engaged in the testing of cattle, the work involved very little additional cost to the Department.

STATISTICS OF SLAUGHTER AND INDEMNITY

There was a further marked decrease in the average amount received as salvage for condemned tuberculous cattle owing to lower beef prices. Appraisals also were considerably reduced. Salvage and appraisal values are given in table 23.

TABLE 23.—*Cattle slaughtered, appraised value, indemnity allowed, and salvage realized, in work of tuberculosis eradication, fiscal year 1933*

State or Territory	Cattle slaughtered	Average appraisal per head	Indemnity		Average indemnity per head		Average salvage per head
			State	Federal	State	Federal	
	Number	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Alaska	1	175.00	25.00	25.00	25.00	25.00	91.66
Arizona	437	56.92	6,392.92	6,392.92	14.63	14.63	11.60
California	14,268	48.72	160,477.47	160,305.40	11.25	11.24	16.25
Colorado	24	114.17	767.17	767.17	31.97	31.97	18.11
Connecticut	5,709	55.48	160,240.61	80,400.76	28.07	14.08	12.80
Delaware	580	56.87	13,597.89	8,992.69	23.44	15.50	9.94
Florida	258	36.72	5,091.42	2,484.70	19.73	9.63	7.08
Georgia	40	37.76	453.56	450.87	11.34	11.27	3.76
Idaho	352	45.04	5,046.69	5,046.69	14.34	14.34	1.92
Illinois	6,719	56.05	92,405.85	92,371.74	13.75	13.75	14.92
Indiana	833	70.37	16,849.49	14,774.83	20.23	17.74	13.63
Iowa	17,009	56.19	259,517.44	253,821.28	15.26	14.92	11.05
Kansas	230	42.80	2,604.00	2,571.43	11.32	11.18	8.96
Kentucky	191	44.41	4,605.20	1,998.24	24.11	10.46	8.72
Louisiana	269	38.92	3,985.43	2,995.31	14.82	11.13	5.31
Maine [1]	172	55.67	6,838.91	2,716.83	39.76	15.80	6.81
Maryland	1,754	63.52	30,447.05	30,447.05	17.36	17.36	11.40
Massachusetts	13,844	74.93	411,056.07	251,515.05	29.69	18.17	13.01
Michigan	557	46.83	12,906.80	6,296.10	23.17	11.30	10.05
Minnesota	3,983	49.32	58,139.41	50,058.05	14.60	12.57	11.59
Mississippi	19	44.42	241.53	208.03	12.71	10.95	2.11
Missouri	144	56.42	2,091.68	2,040.42	14.53	14.17	9.43
Montana [1]	86	43.43	1,701.58	1,137.32	19.79	13.22	3.41
Nebraska	597	48.39	7,348.46	7,193.22	12.31	12.05	12.08
Nevada	25	59.64	541.97	428.59	21.68	17.14	7.33
New Hampshire	960	61.29	28,913.74	15,922.47	30.12	16.59	9.13
New Jersey	10,592	68.44	353,816.87	185,981.57	33.40	17.56	12.46
New Mexico	188	30.28	1,784.20	1,784.20	9.49	9.49	1.80
New York	59,271	53.79	1,829,513.56	800,156.10	30.87	13.50	9.10
North Carolina	49	68.78	906.50	903.17	18.50	18.43	8.36
North Dakota	537	37.61	5,117.69	5,117.69	9.53	9.53	9.13
Ohio	2,287	69.29	41,280.95	37,675.08	18.05	16.47	16.09
Oklahoma	234	41.44	3,976.12	2,794.95	16.99	11.94	5.54
Oregon	456	68.13	6,782.08	6,768.72	14.87	14.84	10.35
Pennsylvania	24,997	67.87	752,159.19	441,701.16	30.09	17.67	11.47
Rhode Island	926	90.45	40,801.00	20,617.56	44.06	22.27	16.03
South Carolina	11	57.73	193.71	193.71	17.61	17.61	4.89
South Dakota	1,063	46.16	12,811.16	12,811.16	12.05	12.05	9.76
Tennessee	300	43.84	3,672.86	3,541.07	12.24	11.80	6.68
Texas	861	88.27	19,542.65	19,542.55	22.70	22.70	5.74
Utah	299	54.95	4,751.09	4,751.09	15.89	15.89	6.91
Vermont	9,167	48.89	135,087.60	131,634.17	14.74	14.36	4.70
Virginia	411	64.81	7,269.96	7,056.95	17.69	17.17	8.89
Washington	873	66.61	15,098.10	14,827.30	17.29	16.98	12.89
West Virginia	143	46.60	2,280.40	1,853.40	15.95	12.96	10.40
Wisconsin	5,152	55.50	75,856.78	74,685.19	14.72	14.50	13.17
Wyoming	161	47.77	2,463.06	2,034.09	15.30	12.63	7.28
Total	187,039	58.34	4,607,452.87	2,777,793.04	24.64	14.85	11.03

[1] Salvage paid to State.

REGULATION OF INTERSTATE MOVEMENT OF CATTLE

Under the provisions of regulation 7, B.A.I. Order 309, approved veterinary practitioners throughout the 48 States continue to conduct most of the tuberculin testing for interstate shipments of cattle. On June 30, 1933, there were on the list more than 9,800 veterinarians, who, under a cooperative plan, are approved by the State and Federal livestock sanitary officials to perform this work. These men tested for interstate shipment 21,479 lots containing 176,721 cattle, of which 0.3 percent reacted. The number tested is a decrease of 50,362 cattle as compared with the number reported during 1932.

In an effort to assist livestock owners in facilitating the interstate movement of cattle, Bureau inspectors tested, under the provisions of the regulations, at public stockyards, 32,817 cattle, of which 0.1 percent reacted. These figures of testing by Bureau and approved veterinarians are included in the total testing for the year as reported in table 21.

DIVISION OF VIRUS-SERUM CONTROL

The Division of Virus-Serum Control, directed by D. I. Skidmore, chief, conducted the administrative and regulatory work authorized by the Virus-Serum-Toxin Act.

WORK AT LICENSED ESTABLISHMENTS

At the close of the year supervision was exercised over 84 licensed establishments, which was the number at the same time last year. These establishments were distributed among 59 cities and towns in 20 States. At the close of the year 43 establishments were engaged in producing only anti-hog-cholera serum and hog-cholera virus, 35 were producing other biologics only, and 6 were producing both classes of products.

Bureau inspectors examined 354,982 hogs and 886 calves intended for use in licensed establishments. Of these, 117 hogs were rejected at the time they were offered for admission, and 16,284 hogs were rejected because of conditions developing later which made them unsuitable for use. Bureau inspectors supervised 3,579 potency and 3,030 purity tests of anti-hog-cholera serum and 3,227 purity tests of simultaneous virus.

OUTPUT OF BIOLOGICAL PRODUCTS

Table 24 shows the quantities of biologics produced by licensed establishments under the Bureau's supervision. Of the total quantity of anti-hog-cholera serum produced, approximately 9 percent was defibrinated-blood serum and 91 percent was clarified serum. The corresponding percentages for the previous year were 13 and 87.

TABLE 24.—*Biological products produced by licensed establishments, fiscal year 1933*

Product	Quantity
Anti-hog-cholera serum and hog-cholera virus:	*Cubic centimeters*
Serum	827,818,533
Virus (simultaneous)	60,889,403
Virus (hyperimmunizing)	160,135,541
Virus (inoculating)	629,964
Aggressins:	*Doses*
Anthrax aggressin	375,370
Blackleg aggressin (natural)	5,994,521
Blackleg aggressin (cultural)	594,055
Hemorrhagic septicemia aggressin	2,138,082
Total	9,102,028
Antisera and sera:	
Abortion serum (bovine)	1,143
Anthrax serum	1,054,791
Blackleg serum	2,168
Bronchisepticus serum (canine)	6,719
Distemper serum (canine)	248,146
Distemper, influenza, and pneumonia serum (equine)	12,980
Encephalomyelitis serum (equine)	515
Erysipelas serum (porcine)	154,112
Hemorrhagic septicemia serum	81,697
Mastitis serum (bovine)	2,377
Mixed infection serum (avian)	18,300
Mixed infection serum (canine)	130,973
Navel-ill serum (equine)	4,200
Normal serum	12,177
Scours serum (bovine)	29,252
Scours serum (feline)	714
Total	1,760,264
	Units
Botulinus antitoxin	68,427,500
Tetanus antitoxin	229,507,400
Bacterins:	*Doses*
Abortion bacterin (bovine) (discontinued)	116,129
Abortion bacterin (equine)	807
Abortion bacterin (porcine) (discontinued)	4,632
Anthrax bacterin	239,175
Autogenous bacterin	141,248
Bacillus colon bacterin	1,825
Bacillus hemolyticus bacterin	21,830
Blackleg bacterin	3,768,610
Cholera-typhoid bacterin (avian)	551,930
Distemper bacterin (feline)	2,755
Distemper, influenza, and pneumonia bacterin (equine)	234,770

Product	Quantity
Bacterins—Continued.	*Doses*
Hemorrhagic septicemia bacterin	1,778,970
Keratitis bacterin (bovine)	227,522
Mastitis bacterin (bovine)	265,406
Metritis bacterin (bovine)	9,499
Mixed bacterin (avian)	3,834,140
Mixed bacterin (bovine)	416,826
Mixed bacterin (canine)	355,372
Mixed bacterin (equine)	73,733
Mixed bacterin (feline)	3,649
Mixed bacterin (lepine)	32,455
Mixed bacterin (ovine)	97,337
Mixed bacterin (porcine)	732,787
Navel-ill bacterin (equine)	65,665
Plague bacterin (porcine)	4,640
Pulmonary bacterin (bovine)	274,058
Pulmonary bacterin (porcine)	153,255
Rhinitis bacterin (porcine)	7,860
Roup bacterin	97,290
Scours bacterin (bovine)	101,219
Scours bacterin (porcine)	130,155
Staphylococcus bacterin	3,226
Streptococcus bacterin	2,559
Total	13,751,334
Vaccines and viruses:	
Abortion vaccine (bovine)	74,893
Anthrax vaccine	2,346,498
Blackleg vaccine	1,373,980
Distemper vaccine (canine)	55,861
Distemper virus (canine)	25,380
Erysipelas vaccine (porcine) (export)	262,676
Infectious laryngotracheitis vaccine	371,000
Pox vaccine (fowl)	8,340,550
Rabies vaccine	346,752
Tetanus toxoid	2,197
Total	13,199,787
Diagnostic agents:	
Johnin	1,973
Mallein (intradermic)	7,385
Mallein (ophthalmic)	47,740
Mallein (subcutaneous)	2,527
Pullorin	1,129,600
Tuberculin (intradermic)	1,715,120
Tuberculin (ophthalmic)	188,210
Tuberculin (subcutaneous)	43,070
Tuberculin (avian)	292,094
Total	3,427,719

PRODUCTS REJECTED

Table 25 shows the quantities of biological products destroyed under the Bureau's direction as unfit for use. Most of these were rejected and destroyed in the course of preparation, but some were recalled from the market for destruction.

TABLE 25.—*Biological products rejected and destroyed under Bureau supervision, fiscal year 1933*

Product	Quantity	Product	Quantity
	Cubic centimeters		*Cubic centimeters*
Abortion bacterin (bovine)	2,350	Hyperimmunizing virus (hog cholera):	
Abortion vaccine (bovine)	10,840	From animals found diseased	3,783,520
Anti-hog-cholera serum:		Contaminated and otherwise unfit	382,941
From animals found diseased	2,885,708	Simultaneous virus (hog cholera):	
Contaminated and otherwise unfit	1,527,746	From animals found diseased	1,089,260
Blackleg aggressin	300	Contaminated and otherwise unfit	1,148,475
Blackleg bacterin	65,300	Tuberculin (intradermic)	6,798
		Total	10,903,238

IMPORTS AND EXPORTS OF BIOLOGICAL PRODUCTS

The importation of veterinary biological products from foreign countries continued to be handled by the Bureau in cooperation with the Treasury and Post Office Departments and the Food and Drug Administration of the Department of Agriculture. At the close of the year two permits to import such products were outstanding. Twenty-one shipments of biologics were offered for admittance to this country. Sixteen of these, upon examination by Bureau inspectors, were found to be biologics which had been exported from the United States but were returned for various reasons. Of the remaining 5 shipments, 4 were admitted and 1 denied entrance because it was not eligible for importation.

During the year Bureau inspectors issued 485 certificates to accompany shipments of veterinary biological products to foreign countries. These certificates covered the following quantities of products: Anti-hog-cholera serum, 16,202,600 cubic centimeters; hog-cholera virus, 859,725 cubic centimeters; aggressins, 203,907 doses; bacterins, 198,264 doses; diagnostic agents, 26,469 doses; sera and antisera, 10,087 doses; and 1,712,500 units of botulinus and tetanus antitoxins; vaccines, 498,166 doses.

The total quantity of anti-hog-cholera serum exported is not known, but the total quantity reported to the Bureau as having been exported aggregated 27,104,700 cubic centimeters.

ZOOLOGICAL DIVISION

The scientific investigation of animal parasites and the development of control measures along the lines of medicinal treatment of infested stock and prevention by sanitary procedures were continued under the direction of Maurice C. Hall, chief.

Cooperation was continued with the Extension Service, by the detail of one man for this work. During the year several States were thus aided in organizing and conducting parasite-control work.

PARASITES OF HORSES

NEMATODES

An examination of encysted nematode larvae beneath the mucosa of the colon and caecum of the horse was made to determine what species develop there. Molting stages of two species of *Cylicocyclus* were identified and other species were also present. Apparently, numerous species develop beneath the mucosa.

Experiments on the possibility of destroying eggs and larvae of nematodes in horse manure, by means of live steam, showed that steam at 15 pounds' pressure admitted to a specially constructed manure box destroyed all eggs and larvae of strongyles in about 30 minutes.

Experiments on the ability of horse strongyle larvae to migrate upward in soil showed that there was practically no upward movement in clay soil. In a mixture of sand and clay some larvae migrated to the surface from a depth of 4

inches, and in sandy loam some larvae migrated to the surface from a depth of 5 inches. This information has a practical bearing on the control of horse parasites by plowing fields contaminated with eggs and larvae of strongyles.

ARTHROPODS

It has been determined that the common horse bot, *Gasterophilus intestinalis*, reaches the stomach of the horse in from 21 to 28 days after the larvae are taken into the mouth. The experiments indicate that the animal can be treated successfully for bots 1 month after the disappearance of the adult flies in the fall, provided the animal has not become reinfested with other larvae from botfly eggs on the hair coat. This source of contamination can be avoided by destroying the eggs on the coat with suitable disinfectants.

PARASITES OF RUMINANTS

NEMATODES

New facts concerning the development of the lesser stomach worm, *Ostertagia circumcincta*, in sheep have been ascertained, the facts being at variance, in some respects, with views previously accepted.

CESTODES

In studies to determine the mode of transmission of tapeworms parasitic in the intestine of domestic ruminants, it has been found that the infective stages survive on pastures through the winter in the latitude of Beltsville, Md., that ruminants may acquire an infestation on bare lots recently polluted with the gravid segments of the worms, and that feeding of tapeworm eggs to sheep does not immunize them against infection.

Tests to determine the period during which *Cysticercus bovis* in beef remains alive in a cooler, showed that these larval tapeworms were still viable after 21 days' retention, the period previously believed adequate for the destruction of their vitality. Some of these parasites in beef were still alive after retention in a cooler for 26 days, but none were alive after 31 days.

TREMATODES

Investigations on liver-fluke control were carried out in Oregon, Washington, Utah, Montana, Idaho, Arizona, Nevada, and Wyoming. Fluke-infested areas were located, and control methods for the destruction of flukes in sheep and the destruction of snails on pastures were demonstrated.

In a continuation of investigations on the life histories of flukes infesting sheep and cattle, two snails, *Pseudosuccinea columella* and *Fossaria modicella rustica*, were found to be suitable intermediate hosts for *Fasciola hepatica*, the common liver fluke of sheep and cattle. These snails were obtained from areas in the Rocky Mountain States where the fluke is abundant, and it is probable that these mollusks are the important vectors of this parasite in that region. These two snails, as well as *Fossaria modicella*, were also found to be suitable intermediate hosts for the large American liver fluke of cattle, *Fascioloides magna*.

PROTOZOA

In studies on anaplasmosis of cattle, three lines of investigation were followed, namely, (1) studies of ticks as carriers of the disease, (2) studies to determine the nature of the etiological agent, and (3) experiments on chemotherapy.

The brown dog tick, *Rhipicephalus sanguineus*, previously reported as transmitting the disease when the seed tick engorges on a carrier and the nymph in turn bites a susceptible bovine, has been found to transmit anaplasmosis also when the nymph engorges on a carrier and the adult tick subsequently bites a susceptible bovine. *Ixodes scapularis* also was found to be capable of transmitting anaplasmosis under experimental conditions. Hereditary transmission of anaplasmosis through the egg was accomplished only in the case of the cattle-fever tick. Attempts to cultivate the etiological agent of the disease in vitro have failed. Tests of various drugs as possible therapeutic agents have thus far yielded only negative results.

A study of piroplasmosis, in Louisiana, has shown that two species of *Babesia* occur in that State, namely, *B. bigemina* and *B. argentina*.

ARTHROPODS

The details of the first 4 years of an experiment in the eradication of cattle grubs in Prowers County, Colo., were set forth in last year's report. During the fifth year of this investigation the work yielded the following results: The number of grubs per animal in the critical or central zone was 5.1 as compared with 9.2 during the previous year and with 35 during the first year. The average labor cost per animal for each working was 5.1 cents. Results of studies of insecticides and methods of application indicate that infested animals can be effectively and safely treated by the owner with small medicated rods inserted in the warble holes. This method appears to be the most effective, rapid, and safe so far devised for use by the cattle owner. Of a large number of formulas tested the one which gave the best results is: Gum arabic, 6 drams; glue, 2 drams; tannic acid powder, 2 drams; derris powder, 1 ounce; and enough water to make a stiff paste. This paste is then rolled into the form of rods. When properly used, the rods are 100 percent effective in killing grubs. The ingredients are harmless to cattle, and the preparation is easily standardized. There appears to be little danger of spreading infection from one lesion or animal to another, a thing which often occurs when infected instruments are used.

Results of experiments indicate that undiluted commercial pine tar applied to the noses of sheep has little or no efficacy in preventing infestation by the grub *Oestrus ovis*.

PARASITES OF SWINE

Experimental procedures on the control of kidney worms of swine have been continued in cooperation with hog raisers in southeastern Georgia. Careful post-mortem examination of 125 pigs raised under a special set-up for kidney-worm control showed that only 4 percent had a slight infestation in the kidney region; 85 percent of the livers from these pigs were passed for food. In an equally careful post-mortem examination of 291 pigs raised on clean ground and with due attention to sanitation, but not under the special set-up, 23 percent showed infestation in the kidney region; only 32 percent of the livers from these pigs were passed for food. Two control herds, consisting of 28 pigs, raised without any sanitary precautions, showed, on post-mortem, infestation of the kidney region in 32 percent of the pigs; only 3.5 percent of the livers were passed for food. These results show conclusively that losses from kidney worms, which are considerable in the South, can be materially reduced by strict attention to the sanitation procedures developed by this Bureau.

In a continuation of experiments on the portals of entry of kidney worms into the bodies of swine, it was determined that the infective larvae gain entrance through the intact skin when they have adequate traction. Although previous work, showing that larvae suspended in water will penetrate only the scarified skin, has been confirmed, it has been shown that larvae contained in a culture medium consisting of charcoal and manure will penetrate the intact skin when the culture is placed on the skin. It is evident from these findings that pigs lying on infested pastures may become infected with kidney worms as a result of the penetration of larvae even through the intact skin.

Numerous tests were conducted in the course of an investigation to develop additional procedures for destroying the vitality of trichinae by processing of pork products customarily eaten without cooking. What appears to be a satisfactory method of processing pork loins has been developed, but additional tests are necessary before this method can be accepted as a recognized procedure.

In studies designed to determine the relation between dietary deficiency and susceptibility to parasitism, some pigs, fed on a diet deficient in vitamin A and showing symptoms of this deficiency, were experimentally infected with the *Ascaris* of swine and others with the *Ascaris* of man. The pigs to which the human ascarid eggs were administered failed to become infected with the adult worms, whereas the pigs which received swine ascarid eggs showed from moderate to heavy infestations with grown worms. In this connection comparative tests were made to determine the effects of avitaminosis on the susceptibility of rats to a nematode, *Nippostrongylus muris*. The results showed conclusively that this dietary deficiency hindered the development of a resistance to superinfection usually shown by rats on a normal diet. Information collected in the course of the year has confirmed previous findings that certain liver lesions in pigs are due to infestation with *Ascaris*. Similar lesions were produced in guinea pigs by administering to them infective *Ascaris* eggs.

Progress was made in experiments to determine the essential facts in the life cycle of stomach worms, nodular worms, gullet worms, lungworms and other roundworm parasites of pigs. These investigations were facilitated by the discovery that some of the species mentioned can be reared to maturity in guinea pigs and other experimental animals; this discovery has aided greatly the study of problems in parasitology relating to domesticated animals.

PARASITES OF POULTRY

COOPERATIVE STUDIES

Investigations conducted in cooperation with the New England ruffed-grouse investigation committee yielded new data concerning parasites of ruffed grouse and spruce grouse. The specimens studied were from Alaska; in previous years specimens studied were from New England and Labrador.

In cooperation with the Bureau of Biological Survey and with the Quebec Zoological Society, examinations of grouse were made to ascertain whether the presence of parasites might be a factor in recent abnormal migrations. The character of infestation found was thought to be of possible significance.

In cooperation with the Animal Husbandry Division, there were obtained comparative data relative to worm parasites in confined and nonconfined chickens. Examinations of 120 chickens showed that the degree of parasitism in only partially confined or nonconfined fowls was much higher than in fowls confined throughout life. This was true as regards number of fowls parasitized, number of species of parasites represented, and total number of parasites present.

NEMATODES

A new species of *Tetrameres*, markedly pathogenic, was described from bobwhite quail. Descriptions of new species and redescriptions of several previously known species of nematodes of birds have been published.

CESTODES

The dung beetle, *Ataenius cognatus*, was discovered to be an intermediate host for the poultry cestode *Hymenolepis cantaniana*, the life history of which was previously unknown. *Onthophagus janus* and *O. pennsylvanicus* were reported as additional intermediate hosts for *Hymenolepis carioca*. Identifications of tapeworms from various parts of the country have added to available knowledge of their distribution and significance.

PROTOZOA

Experiments to determine whether a certain type of fowl paralysis, so-called "range paralysis", is caused by a protozoan have produced results which indicate that the disease is caused by a filtrable virus. Apparently healthy chickens, inoculated intramuscularly with blood, filtrates of blood, and filtrates of emulsified tissues from paralyzed chickens or turkeys, developed the disease.

As regards coccidiosis, vinegar in small quantities in the drinking water has been found apparently beneficial to chickens artificially infected with the caecal coccidium *Eimeria tenella*, or with mixed species producing caecal and intestinal forms of the disease. The mortality rate, oöcyst production, and amount of hemorrhage were reduced and only a small percentage of the oöcysts produced were capable of sporulation.

MISCELLANEOUS PARASITES

NEMATODES

The occurrence of the highly important Guinea worm, *Dracunculus medinensis*, in the fox, raccoon, and mink in the United States, was reported, together with a summary of all reported human cases in this country, all the cases in man being imported or else not genuine cases. The Iowa Agricultural Experiment Station also reported the above-mentioned parasite during the year. This is the first time this dangerous parasite has been reported authentically from the United States, but the evidence indicates that it has been established a long time and is rather widely distributed.

In a study of the influence of vitamin-deficient rations on the development of ascarids in the dog, it was found that dogs from 3 to 4 years of age which were resistant to infestations with *Toxocara canis* while receiving a normal diet could be infested with this parasite after having received a diet deficient in vitamin A.

CESTODES

A monograph on the cestodes of carnivores has been completed, and descriptions of several new tapeworms have been prepared for publication.

TREMATODES

Experiments have been conducted to determine the toxicity of copper and various copper compounds for snails with a view to developing a more satisfactory method of destroying snails which serve as intermediate hosts for flukes. Metallic copper, copper carbonate, and several copper ores, have been found to be lethal to snails when minute quantities of these substances were placed in large quantities of water.

Miscellaneous investigations of flukes occurring in various wild animals have been conducted. Several new life histories have been determined, and the facts ascertained supply information for the solution of the life histories of related flukes occurring in domesticated birds.

TREATMENT FOR INTERNAL AND EXTERNAL PARASITES

Marked success was obtained in the treatment of infestations with the dog heart worm, *Dirofilaria immitis*, with the drug fouadin. A course of treatment with it resulted in the disappearance of the microfilariae from the peripheral circulation and the destruction of some or all of the adult worms in the heart. The drug can be given intramuscularly without appreciable unfavorable reaction, and its use in this manner does not result in sloughing or abscess formation such as is produced by most antimony compounds when administered in this way. The ease of administration greatly simplifies the technic of treatment. Treated animals showed good clinical improvement and were restored to usefulness. Critical tests with trifluorotrichlorethane for the removal of intestinal parasites of the dog indicated that this compound possesses only a slightly greater anthelmintic efficacy against ascarids and hookworms than does trichlorethane.

Tests have been carried out with a large number of compounds, including all the known vegetable taenicides and various extracts of them, for the removal of tapeworms (including scoleces) from chickens. Although some of these compounds were effective in removing many or all of the tapeworm proglottids, none of the compounds were dependably effective in removing the scoleces.

In critical tests, normal butylidene chloride showed an aggregate efficacy of 98.4 percent for the removal of *Ascaridia lineata* from chickens. In doses of 2 cubic centimeters or more for adult birds, the drug removed all *Ascaridia* present. The aggregate efficacy against the caecum worm was only 4.7 percent, although the drug removed a much higher percentage of the heterakids from some individual birds. As with other chlorinated hydrocarbons given by mouth, the irregular penetration of the drug into the caeca apparently influences its efficacy.

Tests carried out on horses treated with carbon tetrachloride for the removal of gastro-intestinal parasites indicated that there is a marked fall in the blood calcium level and an increase in the bilirubin content of the blood after the administration of this drug. The blood calcium level returned rapidly to normal and symptoms of carbon tetrachloride intoxication were relieved promptly following treatment with either parathyroid hormone or with a 10-percent solution of calcium gluconate.

In tests to determine the effect of normal butylidene chloride on colts, five colts, from 4 to 7 months of age, heavily infested with ascarids, were treated with 0.2 cubic centimeter of this drug per kilogram of body weight. This drug did not inhibit the growth rate of the animals, as has been reported for other anthelmintics. On the contrary, the animals showed greater gains after treatment than before treatment. The treated colts passed many ascarids and showed a marked improvement in physical condition.

Carbon disulphide in a dose of from 8 to 10 cubic centimeters per 100 pounds of body weight was found to be effective for the destruction of the swine stomach worms *Hyostrongylus rubidus* and *Ascarops strongylina*. The drug was only partially effective when given in smaller doses. Carbon disulphide causes con-

siderable gastritis but this is of short duration and apparently results in no detrimental effect on the animal.

Critical tests on lambs indicated that a 1-percent solution of copper sulphate containing 0.75 percent of 40-percent nicotine sulphate was very effective for the removal of the common sheep stomach worm and partially effective for the removal of six other nematode species. The results against tapeworms (*Moniezia* spp.) were unsatisfactory.

INDEX CATALOG AND COLLECTION

The index catalog of medical and veterinary zoology was continued. There were 1,068 accessions of specimens of parasites to the helminthological collection.

U.S. GOVERNMENT PRINTING OFFICE: 1933

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REPORT OF THE CHIEF OF THE BUREAU OF BIOLOGICAL SURVEY, 1933

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D.C., August 31, 1933.

SIR: I present herewith the report of the Bureau of Biological Survey for the fiscal year ended June 30, 1933.

Respectfully,

PAUL G. REDINGTON, *Chief.*

Hon. HENRY A. WALLACE,
Secretary of Agriculture.

IMPORTANCE OF WILD-LIFE RESEARCH

Interrelationships of wild animals to their natural environment and to man can be properly evaluated only through the application of scientific principles developed by trained biologists. Research is therefore essential to the perpetuation of the harmless, interesting, or valuable species, and to imposing the right degree of restraint on those that would play havoc with human endeavor if left to increase in numbers unmolested. Throughout its 48 years' work the Bureau of Biological Survey has thus emphasized the importance of research. So long as there remain any remnants of wild life within the boundaries of the United States, and it is hoped that this will be forever, efficient management of the various species will be called for, as in the case of any other valuable natural resource, and to be efficient, wild-life management must have the fundamental basis of scientific research. Without research there can be no continued use and enjoyment of our native fauna, adoption of rational policies toward wild life, administration of protective laws, improvement in propagation of game and fur species, intelligent acquisition and maintenance of refuges for game and other birds and mammals, or dissemination of reliable information on any of these subjects.

The research conducted by the Bureau is concerned with the utility, geographic distribution, migrations, and relationships and classification of the various species in the native fauna; with their food, breeding, and other habits; with the nature of their diseases and the effects of these upon man and his domestic animals; with the food plants and other environment essential to refuge establishment; with methods of control of species that become a menace to farming, stock raising, game propagation, and forest and refuge administration; and with the relative abundance of waterfowl from year to year, including studies of causes of diminution, and development of measures to protect and conserve the various species.

Some of these lines of research have been continued from the beginnings of the Bureau; others have been added from time to time to meet changing conditions. Studies in methods of controlling injurious species and investigations relating to fur farming and game propagation, disease recognition, and where possible, remedial measures, have been extended and intensified; the same is true of research in the protection of the game, insectivorous, and other migratory birds that not only are valuable economically but serve to delight nature lovers and attract sportsmen to their haunts in proper season. All these more recent lines of study have had the benefit of fundamental research earlier undertaken.

EVENTS OF OUTSTANDING IMPORTANCE DURING THE YEAR

The following matters, most of which are commented upon in some detail in this report under appropriate sections concerning wild-life research, utilization, control, or protection, are regarded as outstandingly important in connection with the work of the Biological Survey during the past fiscal year:

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Verification of reports that eelgrass had almost disappeared on the Atlantic coast, destroyed probably by a bacterial disease, with accompanying great reduction in the numbers of brant and, to a lesser degree, of other waterfowl.

Cooperative biological survey of areas across northern Mexico, to collect scientific specimens and data for correlating life-zone findings there and in southwestern United States.

Analysis of the contents of 4,116 coyote stomachs, constituting a material contribution toward a knowledge of the food habits of this predator, of value in determining control policies.

Completion of a 6-year intensive study of the life history, habits, and economic status of the elk in the Jackson Hole district of Wyoming.

Demonstration, through cooperative studies, of the prevalence of several infectious diseases that menace wild life, and of the importance of certain parasites of wild animals and birds in spreading bacterial and other diseases.

Determination of feed requirements for carrying rabbits through weekly periods from weaning to various marketing ages, and demonstration that these requirements compare favorably with those of other classes of livestock.

Suppression of a serious outbreak of rabies in predatory animals in southern New Mexico in an intensive 2-month campaign.

Furthering rodent control on national forests, by more than 1,500 Civilian Conservation Corps workers, and completion of plans under the Emergency Conservation Act for treating 1,650,000 rodent-infested acres on Indian reservations.

Organization of 312 county and community antirat campaigns in 21 States east of the Mississippi River, conducted at low cost to cooperating farmers and greatly reducing losses from rats in growing and stored products.

Establishment of a migratory-bird refuge including the Boulder Dam Project, by reservation of public lands by the President, and temporary withdrawal for further detailed investigation of public lands in Nevada for an additional refuge.

Institution of construction and other work for improving three eastern migratory-bird refuges by Civilian Conservation Corps camps.

Completion of field examinations of 141 migratory-bird refuge units, aggregating 3,710,927 acres in the 48 States, and the surveying, monumenting, and posting of 543 miles of bird-refuge boundaries and subsidiary lines.

Making the District of Columbia a game sanctuary, by act of July 14, 1932, under which it is unlawful to hunt or needlessly disturb waterfowl on any of the waters of the District.

Prescribing a 2-month open season for migratory waterfowl, closing the season on 2 species of ducks, reducing the daily bag and possession limits on 10 others, restricting to 25 the number of live-duck decoys that may be used, and reducing the bag limit on mourning doves to 18 a day.

More effective provision against entry of injurious foreign species of animals and birds, by revision of regulations, published by the Treasury Department in cooperation with the Department of Agriculture.

INVESTIGATIONS OF WILD-LIFE HABITS AND RELATIONSHIPS

BIOLOGICAL INVESTIGATIONS OF MIGRATORY BIRDS

PLIGHT OF WATERFOWL

The Biological Survey's studies of conditions affecting waterfowl in the United States and Canada were intensified when it became apparent that these game birds were passing through a critical period, because of drought, overhunting, and land settlement. Analyses of new data obtained, together with information gathered over a period of years, have enabled the Bureau to center attention upon features of vital importance to the birds. The field studies in gathering facts were the most extensive and carefully planned thus far undertaken and covered important regions on the breeding grounds, during fall and spring migrations, and on wintering areas along the Atlantic, Pacific, and Gulf coasts, and on inland waters.

Through culmination of generally unfavorable conditions, including overshooting and the cumulative effects of long-continued drought in many of the most important northwestern breeding areas, the waterfowl population reached the lowest point on record in 1931. In 1932, because of the reduced season and some improvements in breeding, the conditions appeared to warrant a season of 2 months. Although conditions in the spring of 1933 promised much improvement, the drought that prevailed in certain sections after the first of June seems to have offset any substantial promised gain, and the numbers of ducks cannot be held to have increased materially over those of 1931. Since that year marks the

lowest known point, the present status of waterfowl must be considered alarming and to warrant further restrictive measures.

The development of agriculture and industry during recent years has had a disastrous effect on waterfowl over immense areas, and the original conditions can never be restored. Species that have a wide breeding range and display a high degree of adaptability in selecting nesting sites and making use of new sources of food, including the grainfields of advancing agriculture, or are alert in escaping hunters, give greatest promise of survival in reasonable numbers. Human aid is called for, however, in the form of intelligent management of open seasons and bag limits, wider adoption of sportsmanlike practices, and more adequate provision of sanctuaries. Under present conditions enormous areas formerly important to the birds inevitably must be eliminated permanently from consideration as worth-while breeding range, and future conservation action must be guided accordingly. Much of the eliminated area lies within the comparatively restricted breeding range of some of the most highly prized waterfowl, including canvasback and redhead ducks. It is apparent that special effort in behalf of the birds must be made along constructive lines if they are to remain a measurable part of the attractive and valuable wild-life resources of the Nation. In other words, without better protection, some species may become extinct.

BANDING GAME AND OTHER BIRDS

Specific study of individual birds marked with numbered bands has continued to enlist the active interest and assistance of more than 1,800 cooperators and to yield results of scientific, educational, and administrative value. More than 250,000 birds of various species were thus marked during the year at trapping stations conducted by cooperators, and about 16,600 reports of birds that had been retaken were received by the Survey. Responses to inquiry indicate that at these banding stations equipment maintained without expense to the Department exceeds a value of $75,000, and that time and material valued at not less than $100,000 are contributed annually by station cooperators.

Owing to the importance of obtaining reliable data regarding game birds, special attention has been given to the operation of waterfowl-banding stations. Effort is made to carry on this work in regions from which definite information is needed regarding the migratory routes or sources of supply of game birds, and 50 such stations were operated in 20 States and 4 Canadian Provinces, extending from British Columbia, Washington, Oregon, and California east to Massachusetts, Maryland, and South Carolina. During the year 31,669 ducks and geese were banded, representing an increase of approximately 8,500 over last year. Significant data also were obtained regarding hand-reared mallards and black ducks that had been released in the wild and as to sex ratios in ducks.

In order to obtain adequate knowledge of their general habits, distribution, and migrations, much attention also was given to banding various gulls, terns, herons, crows, blackbirds, finches, and other species, which from time to time run counter to human interests and for which control measures are often demanded.

Through a plan of cooperation with the Austin Ornithological Research Station, on Cape Cod, Mass., unusual laboratory, trapping, and other equipment is available on a 700-acre sanctuary frequented by resident and migrant birds increasingly representative of the New England fauna. Approximately 47,000 individuals of a great variety have been banded at this station—20,000 during the past year, of which 1,200 were black ducks. Good results have been accomplished through systematic observation and through maintenance of nesting boxes and other means of increasing the attractiveness of the sanctuary. The resulting large increase in the numbers of ducks at the station was especially noticeable and proved a useful demonstration of the benefits that may accrue to a community maintaining bird sanctuaries. Over a long period during winter, rafts of ducks varying from 200 to 1,000 rested daily in the waters of the adjoining bay and on the neighboring flats. In the course of the work with ducks an obscure disease of the feet and mouth was noted, and arrangements were made for a cooperative study of its nature, the causative factors, and possible remedial measures.

LOCAL STUDIES OF BIRD DISTRIBUTION

Considerable field work was done in determining the distribution and abundance of the tricolored blackbird in California, where this species is of much concern to rice growers. Data were obtained also on the further spread of the European starling in the United States. At the request of the Louisiana Department of Conservation assistance was given in field work and in the preparation of a new report on the birds of that State. In addition, assistance was given individual orni-

thologists in the preparation of reports on the birds of Oregon, Utah, Wyoming, Iowa, Missouri, Indiana, Ohio, Virginia, North Carolina, and the Connecticut Valley in Massachusetts.

BIG-GAME RESEARCH

Investigation of the life history, habits, and relationships of the southern herd of elk in Wyoming, and of the factors affecting its welfare was concluded. The report prepared summarizes the results of previous work and sets forth accomplishments during the past 6 years. The feeding habits of elk in relation to livestock production are discussed, the feeding and breeding range, winter feeding, diseases and predators, and other features that relate to management practices, the welfare of the herd, and its recreational enjoyment, and use by man.

Incidentally, valuable information has been obtained regarding mountain sheep, moose, and other wild life of the Jackson Hole region and the Teton and Yellowstone National Parks areas. This investigation has been carried on in cooperation with the Forest Service and the Bureau of Plant Industry, of this Department, the National Park Service, of the Department of the Interior, the State Game Commission, and the University of Wyoming. It represents a notable advance in the modern trend to base wild-life administration on ascertained facts

A mimeographed leaflet (Bi-1274) on raising deer in captivity was issued during the year.

LIFE-ZONE INVESTIGATIONS

Under a plan of cooperation with the Museum of Comparative Zoology of Harvard University, whereby all traveling expenses were donated, a field naturalist of the Survey made a study of the animal life across northern Mexico adjacent to the United States. A valuable collection of rare and little-known mammals, birds, and reptiles was thus obtained, and information was gathered on the habits, distribution, abundance, and value of the mammals and birds and on the life zones in relation to those of the United States.

Field work in Georgia resulted in largely completing records of the distribution of breeding birds and mammals and working out boundaries of the life zones of that State. Similar work, required as a basis for a report on the mammals of Arizona, was carried to completion, and much preliminary work was accomplished on the identification of the animals that occur in that State. A report on the mammals of Oregon, completed during the year, is planned for publication in the North American Fauna series of the Bureau.

SCIENTIFIC REFERENCE COLLECTIONS AND RECORDS

A check-up was made of all specimens of deer available in the Biological Survey collection, the National Museum, and in the various museums of California, as a basis for a much-needed study of the deer of the Pacific coast region.

During the fiscal year, 844 mammal specimens were identified for 39 institutions and individuals in 25 States. Loans of 160 specimens were made to 10 institutions in 7 States and 1 foreign country. Three hundred and thirty-two mammal specimens were received for deposit in the collection. Members of the Survey staff described 23 mammals as new, and there were added to the Biological Survey collection 24 new type specimens, bringing the total to 854.

Field work chiefly in North Carolina, Georgia, and Virginia, and donations by cooperators have added 600 bird specimens to the reference collections. Approximately 1,000 birds were identified for individuals and cooperating scientific institutions, and extensive work was done in keeping identifications of the Biological Survey reference collections of birds in accord with recent systematic revisions and current usage. These collections now include more than 67,000 specimens. More than 95,000 records on migration and distribution of birds were added to the carded data.

FOREST WILD-LIFE RESEARCH

In the Lake States region, particular attention has been given to rabbits, which there are approaching a peak of abundance and now present serious problems in forest nurseries and reforestation areas, and in connection with disease conditions, which may affect quail, ruffed grouse, various fur bearers, and other wild life, as well as man. These problems are being studied by the Survey along broad lines in cooperation with the University of Minnesota, the State Conservation Commission, the State Agricultural Experiment Station, and the Lake States Forest Experiment Station. Poisoning methods were determined and demonstrated to

forest officials for use in protecting the seedlings and young trees from snowshoe and cottontail rabbits, and deterrent applications were tested to safeguard young trees from damage by rabbits and to protect planted seed against various seed-eating birds and mammals. As a necessary aid in the tree-planting program under the Emergency Conservation Act, the Forest Service has called upon the Survey to control the rabbits and thereby safeguard this large public investment.

In an effort to determine the extent to which the movements of rabbits are local or regional, which information has a direct bearing on control measures required in reforestation areas, about 2,000 were trapped and tagged. The results show that snowshoe rabbits commonly range between one eighth and one fourth mile, and the longest seasonal movement recorded was 2 miles. Cooperation was continued with the medical department of the University of Minnesota and the State Conservation Commission in the study of tularemia as it affects rabbits and other mammals, birds, and man.

Study of the behavior and feeding preferences of rabbits led to recommendation to foresters of the Superior National Forest area that the less frequented open spaces be planted during years of heavy infestation, leaving brushy lands for planting at times of rabbit scarcity, so that the small plants might attain sufficient height to escape serious damage before the next period of abundance.

The abundance and movements of mice and other small mammals in the various types of forest cover and soil were studied in the Appalachian, Lake States, and southwestern regions, and the effect upon the rodents of burning, clear cutting, and slash disposal. Experiments indicated that fires are not very effective in reducing the population of seed-eating mice, and that added protection provided by a ground cover of slash enables them to multiply rapidly and thus to interfere with natural reforestation and with seeding and planting efforts.

In Arizona, particular attention has been given to studies of the life history and relationships of wood rats, of the abundance of rabbits, and of the relation of rodents to Douglas-fir reproduction. A comprehensive and promising study of range conditions as affected by livestock and rodent grazing has been arranged under a cooperative plan between the Survey, the Forest Service, the University of Arizona, and the Carnegie Institution of Washington.

Game-management studies in the Appalachian area included the relationship of predators, especially the gray fox, to the game-bird population. Rapid increase of deer in the Pisgah National Forest during years of rigid protection developed a condition of overcrowding and overgrazing demanding intensive study, with a view to maintaining the herds on a sustained basis and at the same time permitting controlled hunting for food and recreation. At the request of the Forest Service, representatives of the Biological Survey joined in checking up results of the regulated hunting permitted in the fall of 1932. The hunting plan employed under direction and supervision of Forest Service officials proved a practical way of regulating overpopulation and providing for recreational and economic use of the surplus. Fully 90 percent of animals examined showed infestation by a roundworm (*Gongylonema* sp.) in the tongue and throat.

The experimental introduction of beavers into western North Carolina forests has met with success. The increase observed indicates that beavers should in time prove an important factor in regulating water run-off and under controlled trapping provide a valuable source of revenue from the skins.

Studies of the life histories, distribution, and abundance of both birds and mammals that are of primary importance in an investigation of the relations of wild life to forestry have been continued as in past years.

Assistance was given the Bureau of Entomology in determining in the Eastern States the role of rodents and other animals as hosts of the ticks that transmit spotted fever to man.

ALASKAN REINDEER INVESTIGATIONS

Investigational work was continued at the Survey's Reindeer Experiment Station at College, Alaska, in cooperation with the College of Agriculture and School of Mines, and along the Bering Sea coast and on Nunivak Island from the Bureau's substation at Nome. The investigations are designed through experiment and observation to determine proper methods of managing the grazing ranges and handling the reindeer. Gratifying success has attended the experiments at the station and on Nunivak Island in crossing reindeer and caribou. The crossbred fawns average distinctly larger at birth and have grown into superior animals in each age class. The increase in size runs from 50 to 100 pounds per animal in adult stock. Studies of the grazing ranges and feeding habits of the reindeer were continued as a basis for grazing allotments and herd management.

Analysis is being made of data assembled during the past 12 years to determine the grazing practices essential to maintenance of winter-forage production, which is one of the most critical problems in reindeer use of the range. A manuscript bringing to date the available information and recommendations on herd and range management has been completed for publication as a farmers' bulletin. Cooperation was continued with the Bureau of Animal Industry of this Department in a study of the food values to reindeer of Alaskan range forage, grain, and hay.

INTRODUCED MUSK OXEN

Of the 34 musk oxen introduced into Alaska in 1930, 29 remain and are in excellent condition. The animals are now 3 and 4 years old and have made satisfactory growth. The average fall weight of the older animals was 423 pounds for bulls and 392 pounds for cows; the average for the younger was 348 pounds for bulls and 340 pounds for cows. It has been demonstrated that musk oxen may be gentled and handled successfully in feed lot and pasture. The animals have proved to be good rustlers. In summer they feed on grass, sedge, and browse, and in winter they graze on dried grasses, particularly marsh grass and redtop, and browse on twigs of a number of shrubby plants. Feeding experiments have been continued with sedge hay, redtop, marsh grass, and other native forage, and with such cultivated crops as bromegrass, vetch, pea hay, and oat hay raised for this purpose on the college farm where yield and cost data were obtained. Analysis of materials obtained in connection with the various feeding tests were made in cooperation with the Department's Bureau of Animal Industry.

Experiments conducted by the Agricultural College resulted in the successful weaving of musk-ox wool in mixture with that of domestic sheep. Demonstrations by the College Extension Service in southeastern Alaska created a considerable demand for the wool for local manufacture of scarfs, socks, and jackets. The lightness, softness, and warmth of the garments are attractive features.

ECONOMIC INVESTIGATIONS OF WILD LIFE

FIELD INVESTIGATIONS OF INJURIOUS BIRDS

In studies of damage by birds in California and research in control methods, assistance was given to State horticultural commissioners and other cooperators. Methods were perfected for reducing losses from attacks of linnets and goldfinches on buds and fruits, and it was found that effective control could be obtained without appreciable mortality to other species. Tests of traps were carried on in an effort to devise a means of reducing damage by English and crowned sparrows to flower and garden seedlings, depredations that usually occur where poisoning is impracticable. Injury to rice by blackbirds remains a major problem, though by means of life-history studies and control tests the efficiency of repressive measures was improved.

Depredations on crops by migratory wild fowl continue to be serious. Studies were made of damage by mallards and other ducks to hog millet in Colorado, sorghum in Oklahoma, and corn in Nebraska and Idaho. In the case of federally protected game birds the problem is a vexing one. The birds themselves face so many destructive factors that they are in need of special protection, yet locally they sometimes concentrate in such great numbers as to do serious damage. The losses frequently fall on persons who derive no benefit from the presence of the wild fowl as game, and there is constant demand for reimbursement for losses, payments for which, however, are not authorized.

Upon investigation of a night-heron roost in a Massachusetts village, permit was issued for aggressive measures to dislodge the birds, which were creating a nuisance. A study of depredations by starlings on cherries and other fruits in New York State resulted in recommendation of control measures. Inspection of plantations of berry-bearing ornamentals in Oregon failed to corroborate charges of serious damage by birds, the latter not resorting much to the berries until after frost had softened them and rendered them unmarketable.

Investigation of damage to game fishes by cormorants on a Federal bird refuge in New Mexico did not disclose sufficient evidence to call for any change in policy as to bird protection on the refuge. Investigations were made also of the fall food habits of the great blue heron on the Upper Mississippi River Wild Life and Fish Refuge, and of gulls and other waterfowl in relation to smelt in the Columbia River. Study of the economic status of the white-necked raven was continued in Texas, work on the fish crow in relation to waterfowl nests was done in Maryland, and a report was completed on the injurious habits of the crested mynah, an introduced bird established in British Columbia not far from the United States boundary.

FIELD STUDIES OF THE FOOD OF MAMMALS

Investigation of the food of the Texas armadillo was continued to learn whether this animal is destructive to the eggs of quail and other ground-nesting birds. All the evidence was to the effect that the armadillo is not guilty and that skunks probably do most of the damage for which it is blamed. The general food habits of the armadillo are being studied, and indications are that it is so highly insectivorous that it will prove to be chiefly beneficial.

Two months were spent by one investigator in studying the food habits of predatory mammals in the field and in improving arrangements to insure a continuous flow of stomachs from predatory-animal control workers to the Food Habits Research Laboratory at Denver. In further studies of pocket gophers in southern California it was found that under the changed conditions brought about by irrigation, these destructive rodents are prolonging their breeding season. They are now known to reproduce during at least 9 months of the year. The relation of rodents to reforestation received attention in Washington State.

FOOD RESEARCH LABORATORY OPERATIONS

In the Denver Food Habits Research Laboratory there were examined 4,246 mammal stomachs, 4,116 of which were of coyotes, 73 of lynxes, and 33 of armadillos. Special effort was made to study all coyote material collected in fall months, and a report entitled "Autumn Food Habits of the Coyote" was read at the annual meeting of the American Society of Mammalogists and later published in that society's journal.

In the Washington laboratory more than 1,000 stomachs of birds, 775 of mammals, and 6 of reptiles, besides 679 owl and hawk pellets or similar indicators of food habits, were studied. As usual a great deal of this work was cooperative. Analyses for other divisions of the Survey included 604 stomachs of prairie dogs and pocket gophers and 20 of varying hares. For the southwestern quail investigation there were studied 70 stomachs of 3 species of quail, and 19 of hawks, owls, and mammals. Other stomachs analyzed included 65 of bobwhites, prairie chickens, and ravens for the Oklahoma quail and prairie-chicken experimental game-management projects, 85 in connection with a study of an unusual southward migration of sharp-tailed grouse in Ontario and Quebec, 79 of foxes and 29 of quail for the Virginia Commission of Game and Inland Fisheries, and 60 mammal stomachs, 20 mammal intestines, and 183 owl pellets for the Wisconsin quail investigation. These are only the more important instances of this type of work, a service in highly technical lines of investigation that cooperators and correspondents in general cannot do satisfactorily for themselves or get done elsewhere. Many identifications of wild-duck food plants and other material also were made for correspondents, as well as in connection with the Survey's own work.

The analysis of the contents of all stomachs of diving ducks on hand was completed, and considerable progress was made on the preparation of a new publication on propagation of wild-fowl food plants.

The reference collections, so indispensable for food-habits research, were steadily improved during the year, particularly by the addition of skeletal material and seeds. The seed collection in Washington at the end of the fiscal year comprised 4,271 species, representing 1,297 genera.

Among results of other laboratory activities may be mentioned revision of a manifolded leaflet (Bi-729) on magpie control, preparation of new leaflets on the food of the gray fox (Bi-1250), the food of the red fox (Bi-1251), and a preliminary report on the study of the raven's food (Bi-1281), besides three supplements to publications on attracting birds, dealing with fruit-bearing shrubs and trees useful to attract birds in the region from Oklahoma and Texas east to South Carolina and Florida. There was also reprinted for use in correspondence an extract entitled "Bird Allies of the Farmer", from a statement presented in November at the hearing before the Committee on Appropriations of the House of Representatives.

FOOD-HABITS RESEARCH IN FOREST WILD LIFE

Reports on investigations of birds in relation to the white pine blister rust and the white pine weevil were completed, and search was begun for a satisfactory site in New England on which to carry on cooperative study of forest wild-life management.

FOOD RESOURCES OF MIGRATORY WILD FOWL

The Biological Survey has given all possible attention to the serious shortage of eelgrass in relation to wild fowl. In four investigations along the Atlantic sea-

board it was found that brant had decreased enormously and Canada geese to a lesser extent, that the eelgrass was affected almost everywhere, had died out or been greatly reduced in many areas, but of late appeared to be recovering in the southern part of its range. Though it was demonstrated experimentally that the brant will respond to artificial feeding, constructive endeavors along this line or looking toward restoration of eelgrass have been impracticable on account of lack of funds.

Work on the food resources for wild fowl of Wisconsin covering several seasons (including the last) was summarized and a report prepared on the marsh and aquatic vegetation of Wisconsin and its value to wild fowl. Food-resource surveys of proposed Federal migratory-bird refuge sites were made in Florida, Louisiana, Ohio, Illinois, Nebraska, North Dakota, and South Dakota. Following similar studies, recommendations were made as to policy in the case of Federal refuges in Florida, Maryland, Nebraska, and North Dakota, as well as in that of a county game refuge in New York and a private refuge in Missouri. Somewhat extended surveys of waterfowl-feeding areas were made at the request of State officials in Maine and Connecticut, including in the latter case a study of the autumn food of the black duck in salt marshes.

Related work included study of alleged damage to wild-fowl food plants by effluents from a garbage-disposal works on the Potomac River; field investigation and court and commission testimony as to the effect on vegetation and wild life of the construction of dams in the upper Mississippi River; and study of flood-control works near Zanesville, Ohio. Inspection was made of Back Bay, Va., and upper Currituck Sound, N.C., for evidences of recovery of the water plants subsequent to restoration of a lock in the Albemarle and Chesapeake Canal to check pollution. At the close of the year there was unmistakable evidence of improvement.

STUDIES OF ENVIRONMENT FOR UPLAND GAME-BIRD PRODUCTION

Of the series of experimental quail-management projects, 2 were canceled by their sponsors during the year and 1 had not gotten properly started. There remain 7 in active operation—1 in Arkansas, 2 in Oklahoma, 1 in Indiana, 1 in North Carolina, and 2 in South Carolina. Although in some cases provisional arrangements were necessitated, all were regularly inspected. Three additional areas in Maryland and New Jersey suggested as sites for quail management were inspected but not recommended.

WILD-LIFE DISEASE INVESTIGATIONS

CYCLIC LOSSES IN THE WILD

For several years the seriousness of periodic disappearances of game and fur species has caused increasing concern among those interested in wild-life management. Since comparatively few forms of wild life can be propagated profitably under artificial conditions, increased effort is being made to stop the waste in the wild, where it occurs in more or less regular cycles, frequently almost wiping out the groups over large areas. Typical areas are being mapped and plans organized for a study of the fauna over a series of years—through at least one complete cycle, from the period of extreme scarcity through that of maximum density—and to seek the causes of the mortality. In the typical areas maintained under close observation during the past year some species are reaching such a peak of density that an outbreak of a virulent disease and a rapid decline may be expected at any time.

A number of animals recently collected have shown evidence of tularemia, and at the same time parasitic insects capable of spreading this and other infections have been plentiful. It has been demonstrated during the year that both the ruffed grouse and the sharp-tailed grouse are susceptible to tularemia in the wild. This knowledge is significant, as it now is evident that three of the most prominent game species—rabbits, quail, and grouse—may be victims of this disease in natural environment. These studies are conducted in greatest detail in Minnesota, and through the Bureau's cooperation special efforts have been made to correlate the disease findings in that State with those of other North American areas. With the necessary information concerning losses from disease epizootics and other causes, the investigators will develop all possible measures for reducing the extensiveness of these periodic disappearances of wild life.

Looking to the Survey for reliable information and assistance on the subject, State officials and individuals have repeatedly brought to the Bureau's attention situations involving waste of wild life through disease. Outside organizations

are evidencing an increasing desire to cooperate in checking such waste, and to this end several State institutions have offered formal agreements for joint efforts. The Survey should be able to take a more effective part in such cooperative programs when the financial situation improves sufficiently to warrant the necessary appropriation.

FUR-ANIMAL DISEASES

As limited facilities have prevented a thorough investigation of some of the more severe outbreaks of disease in fur-producing establishments, efforts have been devoted largely to investigation of a few pathological conditions that cause the heaviest losses. Progress has been made in a study of fox encephalitis, fox paratyphoid, and distemper. To meet in some measure the need for greater activity in field studies of fur-animal diseases, a fur breeders' organization of national scope has offered cooperation in the form of financial support for this type of investigation. Such aid will further the Bureau's work on fur-animal diseases conducted cooperatively with the University of Minnesota, which receives similar aid and donations of experimental animals directly from fox-farming sources.

Because fur farmers suppose that disease outbreaks on their ranches are started by unhealthy dogs and cats, research on the comparative diagnoses of definite infectious diseases of the two groups has been intensified.

Studies on parasite control on fur ranches have been continued, with special attention to the development of economical methods that do not involve individual treatment. The lungworm problem is a most serious parasitic menace. Following the recommendations of the Bureau, many fox ranchers have adopted the practice of constructing pens with wire-mesh floors or board floors elevated above the ground in such manner as to insure maximum protection against the animals coming in contact with the eggs of lungworms or the eggs or larvae of other parasites.

Progress has been made in studies of a digestive disease that causes a large part of the losses in commercial rabbitries. This is a form of colitis frequently associated with excessive bloating of the abdomen and is particularly disastrous among young stock. It is found not to be infectious, but probably related directly to feeding practices.

GAME-BIRD LOSSES

Through examination of large numbers of game birds a good understanding has been developed of various abnormalities affecting them. Under controlled conditions on game farms most of the losses were found to be due to ulcerative enteritis, entero-hepatitis, nutritional deficiencies, fowl pox, and respiratory infections. Parasitism by protozoans, nematodes, and cestodes has frequently been encountered on premises where necessary precautions have not been observed. It has been demonstrated cooperatively, however, that it is possible to keep flocks of some species of game birds practically free from any trace of parasitism and yet maintain their reproductive efficiency, by holding them in pens with wire-mesh floors raised above the ground.

References in earlier sections of this report have been made to an obscure disease observed in ducks during banding operations, to disease observations of the smaller forest fauna and deer, and to rodent and other hosts of the spotted-fever tick. A motion picture on the western duck sickness was completed during the year through cooperation between the Survey and the Department's Office of Motion Pictures.

LOSSES FROM WATER POLLUTION

Pollution of water frequented by migratory waterfowl during 1933 has been brought to the attention of the Biological Survey on a number of occasions, but even when the areas affected were extensive, the Bureau was without authority to take remedial action. Most reports of losses were localized, however, and were referable to State, municipal, or other authorities for attention.

FUR-PRODUCTION INVESTIGATIONS

SHORTAGE OF FUR ANIMALS ALARMING

The decline in the quantity of fur pelts of all kinds is causing uneasiness among fur merchants in the United States and Canada. Twenty years ago the periodic decreases could have been attributed to destruction of forests by ax and fire, indiscriminate drainage of swamp land, and encroachment of civilization. Although the recent development of automobile and airplane has ended the isolation that once afforded protection to fur animals, the constant decline during the

past decade is directly attributable to over-trapping and to the staging of so-called "vermin" campaigns for the purpose of destroying fur animals that obtain part of their sustenance from birds classed as game. Such activities have even been sponsored by State guardians of wild-life resources, who have placed statewide open seasons on highly valuable fur animals.

The present system of fur-animal conservation and protection has not proved effective. Better laws and stricter enforcement must be obtained without delay if the natural fur supply is to be restored. Though the responsibility of conserving and protecting fur animals as a natural resource rests chiefly with the States, the problem is national in its ramifications and the seriousness of the situation is such that a coordinated policy based on scientific findings should be established throughout the ranges of the several species of fur animals.

FUR-MARKET CONDITIONS

Conditions in the fur markets have shown steady improvement throughout the past year. The general wave of buying during June and July of 1933 advanced prices on the fur markets as much as 60 percent, with the average advance about 25 percent. Shippers and dealers are more optimistic than last year, and the fur industry is catching up on some of its back indebtedness and is liquidating large quantities of skins at a profit.

DEVELOPMENTS IN FUR FARMING

The fox farmers of the United States harvested 150,000 silver-fox skins during the 1933 season, and disposed of the bulk of them at prices that under prevailing conditions were considered fair. A European demand for American silver-fox skins saved the marketing boards and auction companies from disposing of pelts at ruinous prices. Financially the fur-farming industry has been in good shape and the average fur farmer has had no heavy encumbrances. Bank closings, however, created problems in financing the feeding and care of the young foxes that were to provide this year's crop of fur. The Biological Survey assisted fox farmers and their organizations in presenting their case to Governmental agencies as an enterprise justifying financial aid during the critical period. Fox farmers in general recognize that in improving methods of feeding and management they will reduce overhead expenses and thus be assured of increased profits.

RESEARCH IN FUR-ANIMAL PRODUCTION

The Biological Survey's research program on the production of fur animals, including rabbits, has been devoted primarily to measures for reducing operating costs by curtailing waste, lessening feeding and overhead expenses, and at the same time improving the quality of the product. Breeding-efficiency score cards have been perfected and applied toward selection of experimental animals, and the information has been passed on to fur farmers to enable them to select dependable breeding stock and thereby eliminate unsatisfactory producers. During the year the Survey issued a mimeographed leaflet (Bi-1235) on mink parasites, to acquaint producers with methods of prevention and control.

METHODS OF FUR STORAGE INVESTIGATED

Difference of opinion exists as to the merits of refrigeration as compared with fumigation for preserving dressed furs and fur garments. To obtain definite information as to the relative value of the two systems from the fur-preservation standpoint only, a cooperative experiment was inaugurated with 4 storage concerns handling furs in Washington, D.C., 2 of which use refrigeration, the other 2 fumigation. A number of dressed mink, muskrat, and rabbit pelts were placed in the vaults of each concern, and other kinds of fur will be added from time to time. The furs are being examined periodically to compare changes in color, sheen, and general appearance of fur or texture of skin. It is planned to prolong this experiment until the effects of fumigation and refrigeration on all dressed furs used commercially are thoroughly tested.

UNITED STATES FUR ANIMAL EXPERIMENT STATION

Experiments were conducted during the past year at the United States Fur Animal Experiment Station, Saratoga Springs, N.Y., to determine the value of meat byproducts as a substitute for raw meat in the diet of foxes. So far as growth and general health of pups and adults were concerned, no appreciable difference was noticed between the groups receiving the raw meat and those fed on the substitutes. Though foxes receiving raw meat made a slightly more

rapid growth of fur, the meat substitutes were economical and apparently satisfactory. All the diets, however, included some raw meat.

Three years of experimental work have demonstrated that exposing silver and black foxes to direct sunlight turns their fur brown before completion of full growth and primeness of skin. Foxes confined in cool, ventilated, and well-shaded furring sheds from early fall until pelting time show considerably less brown tinge than those kept in breeding pens in the direct sunlight. Since it is possible to produce fur of improved quality in sheds, their construction has been recommended.

Progress has been registered during the year in breeding experiments pertaining to color inheritance of foxes. The data obtained by the Survey, supplemented by information from individual fur farmers, indicate that inheritance of the three principal color phases in foxes—red, cross, and black—is undoubtedly controlled by two unit factors. It is evident that there were at one time two distinctly black mutations of the red fox, one of which, probably in foxes inhabiting the eastern part of Canada, is represented by the standard-bred type of black (silver) fox; the other probably in a native of Alaska, or of the northwestern region of Canada, is represented by the Alaskan black (silver) fox. Biometrical analysis of data reveals only a single-factor difference between homozygous (breeding true to type) red and homozygous standard black and also only a single-factor difference between homozygous red and homozygous Alaskan black. Red is strongly dominant over standard black but shows no noteworthy dominance over Alaskan black. The first generation from a crossing of Alaskan black and pure red foxes shows the cross type of pelt. Indications are that the double recessive genotype apparently is a black (silver) fox. Further investigations are necessary before results of this breeding problem can be definitely reported.

To reduce losses among foxes by accidents in climbing and also to make it unnecessary to provide fox pens with woven-wire floors to prevent digging, the Fur Animal Experiment Station has continued the practice of lancing the branches of the deep flexor tendons in the front feet. This operation has been performed on foxes by fur farmers for a number of years, but it is found that the utmost precaution must be taken not to sever the branches of the tendon too high, thereby causing lameness and a condition commonly known in livestock as "broken down pasterns." One year after being operated upon, some of the animals have resumed their digging proclivities to a marked degree. Toe nails of foxes operated upon are not kept worn down, thus making trimming necessary.

Confining foxes in pens with elevated wire floors has proved to be effective in preventing lungworms, and of value also in treating disease-infested foxes. Vixens not extremely nervous and known to be good mothers were moved to pens with elevated wire floors shortly after mating. The pups were raised successfully, with no lungworm infestation, as long as they were kept on these floors. After being moved to infested ground they were soon infested. Elevated wire-floored pens of sufficient size and proper design give promise of extensive commercial use on ranches where the lungworm problem is serious.

In experiments conducted during the year in polygamous mating of foxes it has been found by microscopic examination of vaginal smears that unobserved matings can be detected. This should make it possible to undertake polygamous mating more extensively and thus reduce the number of males ordinarily required for service. Similar work at the Canadian Governmental Fox Ranch on Prince Edward Island corroborates the Bureau's experience.

CONDITIONS IN RABBIT RAISING

The general decrease in meat prices extended also to rabbit meat, though curtailment of highly promotional rabbit-production schemes has enabled the industry gradually to get on a more substantial basis. The Federal Trade Commission and the better-business bureaus have effectively cooperated with the Bureau of Biological Survey in efforts to abolish misrepresentations and other unfair practices. Federal authorities have closed a number of rabbit enterprises because of such practices, and others have failed or gone into bankruptcy. Many apparently desirable market outlets were thus lost to rabbit breeders, but in their stead a decidedly increased market for the rabbit meat itself has been developed, which is a healthy indication for the future of the industry. Though the market price has been materially lower, the actual cash sales have been much higher, and the rabbit business in the United States is now on a sounder basis than at any previous time. One eastern packing house has entered into a cooperative agreement with a State rabbit breeders' association to kill and prepare for market its entire production under Federal inspection.

UNITED STATES RABBIT EXPERIMENT STATION

During the year all but two of the experiments at the United States Rabbit Experiment Station, Fontana, Calif., that had been carried on for a 1- or 2-year period, were completed. Part of the data has been summarized. Two years' work shows that in well-balanced liberal rations the addition of cod-liver oil or yeast neither increased the gain in young rabbits up to marketing age, at 60 days, nor reduced the feed consumption. In these experiments the feed supplied per breeding doe per year was 108 pounds of mixed concentrates, 225 pounds of alfalfa hay, and a small quantity of green feed. The average doe produced in 1 year 63 pounds of marketable young rabbits. The average number of young raised per doe to weaning age was 19.4. The average number of litters kindled per doe was 4.11, of which each doe raised to weaning age 3.7 litters. Perhaps the most significant data are those showing the feed requirements of doe and young for the production of 100 pounds of live rabbit at 60 days of age. This feed totaled 152 pounds of mixed concentrates, 316 pounds of alfalfa hay, and a little green feed. Thus, the feed requirements compare favorably with those of other classes of livestock. During the year a complete new group of experiments was instituted from which should be developed exact and extensive information on rabbit feeding. Most of these are to run 2 years.

The cooperative work with the University of California on the morphological and physiological study of the growth and development of skin and hair has resulted in a fairly complete series of slides for each day of the latter part of the rabbit's embryonic period and during the postnatal period.

The Bureau's work in experimental rabbit production was explained at numerous rabbit-breeders' meetings in various parts of the country and at the convention of the American Rabbit and Cavy Breeders Association, held in Pittsburgh, Pa., in November. Mimeographed leaflets on rabbit breeding (Bi-1243) and on the Survey's work for rabbit raisers (Bi-1279) were issued during the year, and a manuscript for a new bulletin on rabbit raising was practically completed.

MUSKRAT INVESTIGATIONS IN NATURAL HABITAT

Investigational work at Church Creek, Md., conducted during the past year by the Bureau in cooperation with the University of Maryland and the game division of the State Conservation Department, has developed valuable new information on muskrats. During the 1932 breeding season 16 litters, totaling 47, were produced in pens, an average of 2.9 young per litter. This is a greater number than in the previous year, and more of the young reached maturity. Definite experiments were started to determine by controlled matings the exact period of gestation, which preliminary reports indicate is approximately 29 days.

A careful survey of the various foods that muskrats relish on the marsh showed that 21 kinds of plants were eaten as well as blue crabs, salt-water mussels, and turtles. The important plants were three-square bulrush, saltmarsh bulrush, broadleaf cattail, narrowleaf cattail, wild reed, and saltgrass.

At the close of the year plans were completed for transferring, with the aid of a camp of the Civilian Conservation Corps, the muskrat experimental work to the Blackwater Migratory Bird Refuge, Md., much more extensive and satisfactory equipment being there available.

Pelts of muskrats trapped during the year are being sent to the Washington office at regular intervals by protectors of some of the Federal wild-life refuges. They are then examined and graded by fur experts and forwarded to the raw-fur market for further grading and valuation. These investigations are being conducted to establish definitely the prime-fur period of muskrats on the various refuges, so that the fur crop may be harvested when at its greatest market value. It is planned to conduct similar investigations on the refuges to establish prime-fur periods on other fur animals.

CONTROL OF PREDATORY ANIMALS AND INJURIOUS RODENTS

COOPERATION DURING DEPRESSION PERIOD

Reduced expenditures by county, State, and Federal Governments have resulted in some curtailment of control of predatory animals and injurious rodents. Farmers, ranchers, and stockmen, however, have continued to support the work liberally, often, in spite of their financial distress, making up for the deficiency of public funds by private contributions, recognizing that protection of stock and maximum profits are needed more in hard times than during prosperity.

Federal and cooperative funds permitted field work in 42 States during the fiscal year. Federal funds expended totaled $547,499, of which $31,479 was used

in control-methods research; $288,957 in the control of predatory animals; and $227,063 in the control of rodents and other small-animal pests. The 42 cooperating States provided $370,794. In addition, counties, livestock associations, and individuals, pursuant to cooperative agreements, provided $641,785 for labor and materials in control campaigns.

CONTROL-METHODS RESEARCH

Research in improved methods of controlling injurious animals was continued, and excellent progress was made on major problems. Numerous experiments have been made with fumigants and poisons to develop less expensive and more effective control methods than those now in use. Studies also have been made of repellents designed to drive away certain injurious animals rather than kill them.

CRAWFISHES

Progress has been made in developing a method of controlling crawfishes, which are troublesome in parts of Alabama and Mississippi. These crustaceans make burrows from 1½ to 14 feet deep in the black soil found there, and at night they come out and cut off the young growing corn, cotton, and alfalfa plants. There are from 2,000 to 14,500 burrows per acre, and often the damage is so severe and prolonged that it is necessary to replant the crops 2 or 3 times. A Bureau investigator spent 3 months in cooperation with State officials working on control methods, and substantial progress is being made in the development of agents of control.

BAT ROOSTS

Hundreds of requests are received each year for information on controlling bats, which become obnoxious in dwellings when they congregate to roost in attics, double walls, and other enclosed places. An effective method of control has been developed by Bureau workers, using naphthalene in either flake or moth-ball form, which serves as a repellent strong enough to drive them from the roosting sites. As soon as they have been driven out, the entrance is blocked and the entire colony is forced to seek new quarters. The Bureau recommends the use of repellents wherever possible, and resorts to the use of poisonous gases only when other methods fail.

RODENT BAITS

A new formula was developed for preparing strychnine grain baits that promises to increase efficiency and lower the cost of rodent control. This will be tested thoroughly and released to the operational forces as soon as perfected. Special studies have been made of liquid red-squill extracts to supplement the powdered squill now used in cooperative campaigns against rats. It has been found that increased efficiency results from changing the type of baits for clean-up work following campaigns.

Field and laboratory studies of the effect of thallium on vegetation indicate that heavy concentrations of the metal will kill growing plants, but that these show no injurious effects whatever from the quantities used in rodent baits. A test plot was selected upon which there was a definite record of nine different applications of thallium-treated baits on an area that had been kept denuded of vegetation by ground squirrels. After the rodents were killed the bare spot produced natural vegetation fully as tall and vigorous as on areas not so disturbed. The presence of the baits had in no way injured the fertility of the soil.

Studies were continued of antidotes for thallium, strychnine, and cyanide, and some progress has been made. A short paper on Recent Developments in the Preparation and Uses of Thallium was prepared by James C. Munch, consulting pharmacologist of the Survey, and published during the year in an outside journal, and the same author has prepared for publication by the American Medical Association a paper entitled "Human Thallotoxicosis", a detailed description of the unfortunate human poisoning by thallium in California, referred to in last year's report. That the quantity of poison per bait is being constantly reduced was set forth in an article published in the 1932 Yearbook of Agriculture under the title "Rodent Control Studies Develop Specific Methods for Different Species", which during the past year was reprinted and issued in separate form (Yearbook separate 1342).

STUDIES OF COYOTE RANGING

To gather more definite information on the natural drift of coyotes, 24 animals were tagged and released. From 7 of these returns have been received—4 were

caught within 5 months in the immediate vicinity of the place where tagged; 2 were taken 13 months later, one 10 miles away, the other 100 miles; and 1 was taken 8 months after release, 55 miles distant. The coyotes had been tagged and released in localities where their movements would not be influenced by the shifting of livestock between lower and higher regions. An authentic record was obtained of a wolf that in 2 weeks had traveled a distance of 125 miles, crossing 4 mountain ranges.

CONTROL OF PREDATORY ANIMALS

PROBLEMS SERIOUS WITH REDUCED FORCES

In spite of a decrease of 20 percent in funds available for the control of predatory animals, there has been an increase of 4.81 percent in the number taken by the cooperative hunter force during the past year. During the fiscal year a total of 63,045 predatory animals were taken by Federal, State, and other cooperative hunters working under the supervision of the Biological Survey. This number consisted of 54,942 coyotes, 1,227 wolves, 249 mountain lions, 6,382 bobcats and lynxes, and 245 stock-killing bears.

The low price of furs has in many places resulted in a practical cessation of activity by commercial trappers, who in normal times get a goodly proportion of the annual take. In many sections these men constitute a first line of defense against the ravages of predators, leaving to the Federal, State, and other cooperative hunters the task of trapping areas of light infestation and capturing killers that have become trap shy.

With the falling off in appropriations, fewer hunters were employed, leaving greatly increased areas to be covered by each trapper to keep depredations on livestock to the minimum. This heavy burden has necessarily caused more than normal delay in taking care of complaints of damage. Fortunately, however, the public has realized the difficulties of the situation and has shown creditable forbearance in criticism.

The normal increase of coyotes being rapid, constant warfare is necessary to hold them in check. The average number of young per litter is at least six, and larger litters are common. A Federal hunter recently trapped a female coyote near Kanosh, Utah, carrying 17 unborn young, the largest number of which there is an authentic record. In Colorado another coyote was captured in March carrying 12 unborn young, while litters of 13 and 14 have been previously recorded.

The ability of coyotes to adapt themselves to new conditions was instanced when a Federal hunter located a coyote den in a culvert beneath the tracks of an electric railroad at Hollydale, Calif., over which the cars run regularly about every 10 minutes. The den was only about 50 yards from an inhabited house and close to a boulevard on which hundreds of people travel daily. The fecundity of these animals, coupled with their remarkable adaptive ability, makes control work a real problem. The slackening of activity by commercial trappers and the dropping of cooperative hunters, through shortage of funds, will call for greatly increased activity later on to reduce again the coyote population.

To insure that field practices in control in widely scattered operations shall be in accord with Bureau policies, detailed instructions in the form of a manual, for administrative use only and not for public distribution, were printed and issued during the year to all hunters engaged in predatory-animal control under Bureau supervision. In addition regional supervisors have been in constant touch with district leaders and hunters, and field inspections have been made by members of the headquarters staff at Washington.

SUPPRESSION OF RABIES

One of the most serious outbreaks of rabies in several years recently occurred among coyotes in southern New Mexico and was extended by them into western Texas and eastern Arizona. The malady originated in southern Lea County, near Eunice, N.Mex., in February, and within a month had assumed serious proportions. Many ranchers reported that cattle and dogs were bitten by rabid coyotes and that coyotes were frequently seen in corrals and yards. In one case 18 of 22 sheep bitten by coyotes showed symptoms of rabies and were killed by the owner. Several bulls held in a feed lot were attacked by a rabid coyote, but recovered after being given serum treatment. A milk cow at Mesquite, N.Mex., developed rabies, and an entire family that had been using its raw milk was given Pasteur treatment. One trapper bitten by a rabid coyote also received treatment, and another, attacked by a coyote, killed the animal before it could bite him.

Bureau leaders and hunters in New Mexico instituted a vigorous control campaign in cooperation with the Public Health Service, of the Department of the Interior, the State Public Health Laboratory, the Mescalero Indian Agency, the Extension Service and the Forest Service, of the Department of Agriculture, and the New Mexico College of Agriculture and Mechanic Arts. Extensive trap and poison lines were established, and strict quarantine measures against dogs were adopted on the Mescalero Indian Reservation and elsewhere. After 2 months of intensive work, the rabies outbreak appeared to be well under control.

Another serious outbreak of rabies occurred in Nevada, during which 23 head of cattle died of the disease in Paradise Valley. Although herds of cattle on feed lots at the time were exposed to attack, prompt measures taken to stamp out the disease prevented further serious losses. During the year five positive cases of rabies in coyotes in Nevada were found on laboratory analysis.

GAME DESTRUCTION BY PREDATORS

Mountain lions, coyotes, and other predatory animals continue to be a serious menace to valuable game animals in many sections of the country. The Forest Service recently estimated that from 1927 to 1931, predators killed 505,693 animals on national forests, more than 100,000 a year, including losses among cattle, horses, sheep, and goats in 1930 and 1931. Another estimate for the calendar year 1932 shows that almost twice as many deer were killed in the national forests of California by predatory animals as by hunters. Predatory animals were estimated to have killed 27,611 deer during the year, while hunters during the open season killed only 14,408. The supervisor of the Sierra National Forest reported during the hunting season 42 cases in which coyotes were seen chasing deer. In Colorado, there were recorded three eye-witness reports of coyotes killing deer.

To supplement its series of leaflets on trapping coyotes, wolves, bobcats, and other predators, the Bureau during the year issued Leaflet No. 94, Hints on Mountain-lion Trapping, giving suggestions to the general public on controlling these larger cats where they menace livestock or game.

CONTROL OF RODENTS

Though rodent-control work decreased during the fiscal year 1933, in many areas the reduction was not serious because previous control campaigns had reduced the numbers of rodents to a point where only clean-up and patrol work was necessary. Intensive control measures have been continued on productive lands, but marginal areas have been neglected during the period of financial depression. Warnings to orchardists for the protection of trees from damage by field mice were issued during the winter by means of statements issued to the newspapers.

The acreage treated in Federal and cooperative work for the control of prairie dogs, ground squirrels, pocket gophers, jack rabbits, field mice, kangaroo rats, woodchucks, and other small rodents, was 20,702,451, and the total cost, $855,560. The saving estimated by 82,087 cooperators was $5,025,458.

EXTENT OF LOSSES FROM RODENTS

The damage that may be caused by rodents is illustrated by an incident that occurred in western Nebraska. Pocket gophers burrowed into the bank of a main canal in a large irrigated district and caused a break that resulted in water shortage on 65,000 acres of farm land and a deep deposit of silt on an additional 100 acres. The total damage, including $13,000 for prompt repairs of the break, was estimated at $50,000. At the request of water users, the Survey's leader of rodent control in the district later organized a small crew and carried on pocket-gopher control along 85 miles of ditch bank at a cost of approximately $1,000.

A member of the Utah State Board of Agriculture estimated that in Sanpete County a campaign for the control of ground squirrels conducted under the supervision of the Bureau resulted in the saving of enough forage to feed 6,000 sheep for 1 year. In this county the saving in alfalfa, oats, wheat, and other grains approximated $12,000 to $14,000 while the saving for one county on all crops was estimated at $25,000.

A large proportion of farms, perhaps 75 percent, or 4,650,000 farms in the United States are confronted with a rat problem. According to estimates of 6,000 farmers, the annual loss per farm from rat depredations approximates $40. If this applies to all the affected farms in the United States, farmers are losing $186,000,000 each year from this one destructive pest.

ANTIRAT CAMPAIGNS

During the year, 312 antirat campaigns, organized on county-wide or community-wide bases, in 21 States east of the Mississippi River, were sponsored by the Biological Survey and carried on under the supervision of Bureau leaders and county agents. In these campaigns 126,507 pounds of red-squill baits were used, 112,333 of which were mixed and canned at the bait-mixing station maintained by cooperators at Barnstable, Mass. Use of canned baits greatly simplifies control procedure, since the cooperators have only to open the cans and expose the ready-mixed baits on the eve of the county-wide campaign. These 312 campaigns cost cooperators less than $40,000, an average cost to each farmer of about 50 cents.

In parts of Texas where typhus fever has been spread from infected rats by fleas, mites, and body lice, rat-control operations were continued. An instructive pamphlet issued by the Texas State Department of Health discussed symptoms of the disease, the role of the rat as a carrier, and the reported cases by months since 1924. It emphasized the necessity of cooperative antirat campaigns such as those conducted by the Survey.

A report from Navasota, Tex., indicates that cats may also be carriers of typhus fever. The health authorities learned that one kitten of a certain litter was given to a nurse, who shortly afterward contracted typhus fever; two others were given to a family in the town, some members of which within a short time thereafter became ill with the disease; another of the litter was sent to a person in Long View, Tex., and this person also soon afterward became ill.

PORCUPINES

Porcupine control was continued in forested areas in the Western States, especially in Arizona, California, Idaho, Utah, and Oregon, and also in Pennsylvania. These rodents are destructive to growing trees, and their control has been difficult. Improvements made in control technic should go far toward developing a successful method.

On the Coconino National Forest, Ariz., where the Bureau has carried on extensive control operations in cooperation with the Forest Service, the Office of Motion Pictures recently filmed scenes showing the damage by porcupines and methods developed for control.

COTTON RATS

The intensive campaign for the control of cotton rats carried on during 1932 in one county in Florida, at a cost of less than $600, reduced by 90 percent the losses to truck crops, which local reports indicate had previously amounted to $150,000 a year. The methods of control adopted in that campaign were continued and the area treated has been extended to include several new counties, where like results have been obtained. Truck growers throughout the area report that the methods adopted have yielded excellent results and that the damage from cotton rats this year has been of little consequence.

WOODCHUCKS

The success of antirat campaigns, in which baits are distributed to cooperators at low cost and wide areas are covered simultaneously, has suggested use of the same plan for controlling woodchucks. Fourteen county agents in the East accordingly scheduled cooperative campaigns, during which 2,596 pounds of calcium cyanide were used, a quantity sufficient to treat more than 30,000 woodchuck burrows. Arrangements were made with a large manufacturing company to supply the cyanide at cost and to pack it in convenient-sized containers. The whole procedure was similar to that for the rat campaigns, and in spite of the economic conditions, all county agents found the cooperators responsive to the plan. Excellent results were obtained.

BAIT-MIXING STATION

The cooperative bait-mixing station, established by the Survey in temporary quarters at McCammon, Idaho, in 1927, has recently been moved to Pocatello, Idaho, and installed in a substantially constructed, reasonably fireproof structure. The new building has trackage facilities for loading and unloading car-lot shipments, and is provided with storage space for 1½ million pounds of grain.

Oats purchased for the processing of poisoned bait are of the highest quality. First thoroughly cleaned to remove weed seeds and broken and immature kernels, they are then steamed and rolled so that each kernel is exposed to the poison

treatment. Great care is used in the cleaning, to prevent the spread of noxious weeds and to safeguard birds that might pick up cracked kernels or weed seeds. Generally, rodents prefer the plump kernels. During the year the mixing station processed and shipped to cooperators in 25 States, principally in the West, 734,650 pounds of prepared bait, 262,888 pounds of steam-crushed oats, and 750 gallons of paste for the preparation of woodchuck and rabbit baits. To meet the demand for prepared baits for the rodent-control operations under the President's Emergency Conservation Work program, the Idaho plant operated 16 to 24 hours a day for a period of about 6 weeks, and during this time prepared more than a half million pounds of grain baits.

EMERGENCY CONSERVATION PROGRAM

The President's Emergency Conservation Work program offered an opportunity for the long-needed control of rodents on national forests and Indian reservations, and rodent control was made one of the projects. Under the new program, lands on national forests and Indian reservations will be improved by the elimination of rodents, and marginal areas that have long served as breeding grounds from which adjacent cleared lands privately owned have continually been reinfested will be cleaned up.

Work on national forests was begun early in May, but nothing was done on Indian reservations before June 30 other than to formulate plans, prepare bids for supplies, and select supervisory personnel. Bait materials for use on national forests were purchased from the emergency funds and shipped to the Bureau's bait-mixing station at Pocatello, Idaho, where the bait was prepared and sacked ready for shipment. Regular employees were either transferred to the emergency fund rolls as supervisors or cooperated closely with Forest Service officials in supervising the work. Laborers were chosen from the large central Civilian Conservation Corps camps and assigned to crew duty distributing baits.

A survey of rodent infestation on the national forests had been made during the fiscal year 1930 in cooperation with the Forest Service. Previously the Bureau had also conducted a survey of rodent infestation affecting timberlands on Indian reservations and other public lands. These two surveys indicate that range-destroying rodents, many of which directly affect reforestation, infest a total of 23,920,700 acres. In addition to this infestation, another survey has shown that porcupines are destructive to trees on 6,326,510 acres within national forests.

Rodent control has a definite place in reforestation programs, as pocket gophers, ground squirrels, porcupines, rabbits, and other rodents are in many places destructive to young trees and seedlings, particularly on areas that have been planted. Their working of the surface soil, destruction of ground cover, and burrowing through earthen check dams and drainage ditches are frequently the beginnings of wasteful soil erosion.

For example, rabbits on some plantations in the Superior National Forest in Minnesota are reported by Forest Service officials to have seriously damaged 94 percent of the white pine, of which 64 percent is recent; 85 percent of the Norway pine, of which 59 percent is recent; and 86 percent of the spruce, of which 57 percent is recent. In Wisconsin also plantations were heavily damaged by rabbits.

Close observation of areas in Arizona treated for porcupines during 1931 and 1932 shows that future operations there can be confined solely to patrol work to prevent reinfestation. In Oregon, on the Rogue River National Forest, porcupine infestation has decreased to such an extent as a result of previous control operations that practically no new damage occurred during the past year. Small areas were re-treated during the fall of 1932, and no new work was found necessary in the spring of 1933.

An example of the serious menace of porcupines to forestation is furnished on the Custer National Forest in Montana, where an examination of a stand of natural lodgepole pine at the head of Crooked Creek revealed that at least 30 percent of the timber had been attacked. On areas of the Coconino National Forest in Arizona porcupines have damaged as much as 70 percent of the seedlings and saplings. In many areas where reproduction is difficult, effective stocking is prevented when porcupines each year kill a large percentage of the seedlings.

On the Nebraska National Forest, in western Nebraska, where a large area of open land is being forested, it is impossible to grow the trees without first removing pocket gophers. In mountain areas of the West these rodents are especially destructive as the causative agents of erosion. To aid both the emergency work

in pocket-gopher control on forest and Indian lands and the regular cooperative work elsewhere, a farmers' bulletin (No. 1709) on the subject was completed during the year and submitted for publication.

Rodent control accomplished under the emergency conservation program before the end of the fiscal year was remarkable, considering the speed with which the project had to be established and the difficulties that were encountered. By June 30 a total of 1,433 Civilian Conservation Corps recruits and 136 trained foremen were working under the supervision of Survey leaders on national forests; 468,500 pounds of prepared bait had been treated at the Pocatello mixing station; and, in addition, 50,000 pounds of oats were steamed and crushed for prebait. Plans were made for the purchase about July 1 of supplies and the employment of Civilian Conservation Corps workers to treat 1,685,000 rodent-infested acres on Indian reservations, and for Bureau leaders to supervise the activities of 323 workers and 50 foremen, and in addition for the Survey to supply mixed bait from the mixing station at Pocatello, Idaho.

LAND ACQUISITIONS FOR WILD-LIFE REFUGES

MIGRATORY BIRD CONSERVATION ACT REFUGES

The refuge land acquisition program of the Biological Survey was laid before the Migratory Bird Conservation Commission at two meetings held during the year, one on December 8, the second on May 23. The first was held to consider recommendations for land acquisitions for which contracts had been negotiated during the preceding 5 months. All were covered by leases with options to buy, with the exception of one 160-acre tract on the Long Lake Refuge, in North Dakota.

Recourse to the policy of leasing lands was necessary because the funds with which to make purchases were curtailed and it was hoped that for the ensuing fiscal year appropriations to be made under the Migratory Bird Conservation Act would be sufficiently large to exercise the purchase options. This hope, however, was not realized: sufficient funds were made available to complete only the preliminary work, including boundary surveys, title examinations, and mapping of tracts that had heretofore been approved for purchase.

During the year cadastral surveys were made of 287 miles of boundary and subsidiary lines on refuges being acquired under the provisions of the Migratory Bird Conservation Act, and 256 miles on the Upper Mississippi River Wild Life and Fish Refuge. The boundaries of the lands so surveyed were permanently monumented and posted.

Only $318,000 of the $1,000,000 authorized by the Migratory Bird Conservation Act was appropriated for the fiscal year 1933, and this included $200,000 authorized for obligation during the fiscal year 1932. Furthermore, expenditures of funds appropriated were restricted by administrative limitations growing out of the depression. The total appropriations authorized to date in the 10-year program under this act is $1,875,000. Of this amount only $993,000 has been made available.

The entire program placed before the Migratory Bird Conservation Commission at the December 8 meeting contemplated the acquisition of 10,102 acres, distributed among the Crescent Lake Refuge, in Nebraska; Long Lake Refuge, in North Dakota; Bamforth and Hutton Lakes Refuges, in Wyoming; and the Sacramento Refuge, constituting a part of the famous Spalding ranch in the Sacramento Valley, in California. The second meeting of the Commission, held on May 23, was for suggesting to the new Administration the possibility of stimulating migratory wild-fowl refuge acquisitions under the Emergency Conservation Act of March 31, 1933, but on June 30 sanction had not been given to proceed as recommended.

The Migratory Bird Conservation Act anticipates the establishment of a nation-wide system of refuges, so that wild fowl may follow their natural flight lanes in the migration seasons with a fair chance of finding safe nesting, resting, and feeding places en route. The first year's appropriation under this act was required for examining numerous sites proposed as suitable for refuge purposes. This work is being continued, but with diminishing progress as the finances are reduced. At the close of the fiscal year, 3,710,927 acres of land in 141 units, distributed among the 48 States, had been methodically examined to designate land types, land cover, and values of land and cover; to determine the nature and extent of improvements that might be made; and to ascertain the extent of the individual ownership in each proposed unit. In addition, type maps have been prepared showing the physical conditions, the character of lands, and the soil cover. Some of the units have a great diversity of soil types, and each unit is made up of many

individual tracts under separate ownership. The economic values involved and the uses made of the lands of the different types produce a diversity of values for these individual tracts. Within the 141 units examined 6,756 landowners have title to 3,710,927 acres, an average of 48 owners per unit.

While the Biological Survey was able to take options on 10,102 acres for lease and for purchase during the fiscal year 1933, curtailed appropriations made it necessary to discard two tracts having an aggregate area of 10,790 acres. On the other hand, the Bureau has concentrated its efforts upon surveys, exact-acreage determination, and basic land-grant compilation, all of which are necessary in conveying title to the United States. Title was conveyed to 42,163 acres of land in 8 units in 7 States. In the matter of transfer of titles, this is the largest accomplishment for any 1 year since the work under the Migratory Bird Conservation Act began. In addition to lands purchased, the Biological Survey has taken advantage of every opportunity to utilize for migratory-bird sanctuaries lands in the public domain and lands previously withdrawn for other public uses. The progress thus far made under the provisions of this act is shown in table 1. Of the 137,664 acres thus far approved for purchase and lease-purchase, the average cost has been $4.57 per acre.

TABLE 1.—*Refuge areas acquired and approved for acquisition under the Migratory Bird Conservation Act program, to June 30, 1933*

State and county	Refuge	Areas approved by the Migratory Bird Conservation Commission for purchase and lease-purchase				Other areas acquired	Total
		Acquired by purchase	Pending title conveyance		Total		
			Under purchase agreement	Leased			
		Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Alaska	Semidi Islands					[1] 8,290	8,290
Arizona, Mohave	Boulder Canyon (see also Nevada).					[1] 312,687	312,687
California, Imperial	Salton Sea	8,982			8,982	[1] 36,578	45,560
Florida:							
Levy	Cedar Keys					[1] 224	224
Hernando	Chinsegut Hill					[2] 2,033	2,033
Jefferson, Taylor, and Wakulla.	St. Marks	19,313			19,313	[1] 16,298	35,611
Georgia, McIntosh	Wolf Island					[1] 538	538
Maine, Knox	Widows Island					[3] 12	12
Maryland, Dorchester	Blackwater	8,241			8,241		8,241
Montana, Cascade and Choteau.	Benton Lake					[1] 12,235	12,235
Nebraska, Garden	Crescent Lake	40,609			40,609	[1] 173	40,782
Nevada:							
Clark	Boulder Canyon (see also Arizona).					[1] 346,443	346,443
Churchill	Fallon		3,788	9,594	13,382	[1] 14,114	27,496
Nye	Railroad Valley					[1] 135,184	135,184
New Mexico, Chaves	Roswell					[1] 1,962	1,962
North Carolina, Hyde	Swanquarter	15,341	151		15,492		15,492
North Dakota, Burleigh and Kidder.	Long Lake	4,810	160	2,014	6,984	[1] [4] 1,810	8,794
Oklahoma, Alfalfa	Salt Plains					[1] 19,453	19,453
South Carolina, Charleston	Cape Romain	22,448			22,448	[1] [5] 31,613	54,061
Utah, Box Elder	Locomotive Springs					[1] 1,031	1,031
Washington, Grant	Lenore Lake					[1] 4,682	4,682
Wyoming:							
Albany	Bamforth Lake	965			965	[1] [4] 1,199	2,164
Do	Hutton Lake	1,248			1,248	[1] [4] 460	1,708
Total		121,957	4,099	11,608	137,664	947,019	1,084,683

[1] By Executive order or proclamation.
[2] By gift.
[3] By act of Congress.
[4] By lease without option to purchase; acquisition approved by the Commission.
[5] By cession.

The extensive Boulder Canyon Wild Life Refuge, in Nevada and Arizona, containing 659,130 acres, embraces the Boulder Canyon water power project, much of which is upland and desertlike. But this area has great value for sanctuary purposes for many forms of wild life other than migratory birds.

The Railroad Valley Migratory Bird Refuge, in central Nevada, containing 135,184 acres, is in the nature of a temporary withdrawal and will be made the subject of a more intensive study as soon as funds permit, to determine its ultimate refuge value through development of the water resources. The Lenore Lake Refuge, in Washington, containing 4,682 acres, and the Roswell Refuge, in New Mexico, containing approximately 1,962 acres, are also temporary withdrawals that will be studied further when opportunity offers. Upon satisfactory showing of refuge possibilities, temporary withdrawals will be made permanent. It is anticipated that out of public lands several additional refuge units will be reserved during the fiscal year 1934.

UPPER MISSISSIPPI RIVER WILD LIFE AND FISH REFUGE

On the Upper Mississippi River Wild Life and Fish Refuge, which embraces extensive areas of bottom lands in Wisconsin, Minnesota, Iowa, and Illinois, there are 138,412 acres of land and water now under Federal jurisdiction, of which 77,947 were acquired by purchase, 545 by gift, 13,699 by Executive order, 5,731 acquired by accretion, and 2,745 held under option to buy. Intermingled with the lands so taken under jurisdiction are 18,054 acres of water in sloughs, ponds, and lakes. By reason of the fact that these are entirely surrounded by Government-owned lands, they form an integral part of the refuge and are under administrative control. In addition there are 19,691 acres of contiguous military-, State-, and city-owned and leased land that practically serve as refuge lands. This total does not, however, include the main channel of the Mississippi River passing through the lands, which is estimated to contain 70,000 acres. The Biological Survey has practically exhausted the possibilities of acquiring the remaining lands needed for refuge purposes by agreement with the owners of the tracts involved. To fulfill its responsibilities under the act creating this refuge and in order to round out the several units that go to make it up, the Survey has found it necessary to institute arbitrary proceedings in condemnation. During the year 1933 several such condemnation suits were instituted, and awards by the commissioners of view and by the courts hearing the cases supported the values that had been assigned to the lands by the Bureau. This process must be continued until privately owned lands intermingled with those that have been acquired by the Survey have been transferred to the United States. The lands being so taken are unoccupied and have no agricultural value. Their principal value at present lies in the fact that they are sought to be acquired by the Federal Government in its wild-life refuge program.

During the fiscal year 1933, title to 7,386 acres of additional lands have been vested in the United States through direct purchase and by arbitrary condemnation. The appropriations made available for the continuation of this work, which will involve the acquisition of 10,000 to 15,000 more acres of land, are seriously curtailed for the next fiscal year. For the past year, $34,033 was made available.

The act authorizing the acquisition of lands within this refuge authorized the appropriation of $1,500,000, but the total appropriations have amounted to only $870,033. The indications are that the acquisition of lands within the refuge can be completed for a sum materially less than authorized. To date the average cost of lands taken by purchase has been $6.65 per acre.

BEAR RIVER MIGRATORY BIRD REFUGE

Acquisitions on the Bear River (Utah) Migratory Bird Refuge have been reduced to lands that are to be taken by exchange. Two such acquisitions involve the exchange of 3,034 acres belonging to the United States for 7,733 acres of privately owned lands. Progress in the consummation of these has been exceedingly slow by reason of questions in reference to certain reliction rights.

The total acreage of lands within the refuge, including the exchanges referred to, will be 64,216 acres, consisting of 15,461 acquired by purchase, at an average cost of $1.68 per acre, 7,733 in the process of exchange, 2,773 ceded by the State, and 38,249 acres of public lands withdrawn. In addition easements aggregating 113 acres have been acquired for right of ways over privately owned lands.

CHEYENNE BOTTOMS MIGRATORY BIRD REFUGE ACT

Land acquisition under the Cheyenne Bottoms (Kans.) Migratory Bird Refuge Act of June 12, 1930, was progressing steadily toward consummation by the

process of condemnation proceedings, until terminated for lack of an appropriation. The 52 tracts within this proposed refuge could not be acquired by direct purchase, the majority of the landowners holding out for prices much in excess of the appraisals by the Biological Survey. In addition, titles have been more than ordinarily involved because of several speculative waves incident to oil booms, and now almost every acre in the Cheyenne Bottoms is covered by an oil lease. Drilling has taken place at a number of points there and in the immediate vicinity, so far without success, though oil has been developed in commercial quantities to the northwest and the southeast. Notwithstanding the difficulties, the Biological Survey proceeded with plans for the acquisitions, until in the stress of financial conditions Congress discontinued the appropriation begun in 1930.

WILD-LIFE REFUGE ADMINISTRATION

Wild-life refuges under the supervision of the Biological Survey now number 102, two new ones having been added during the year (p. 23). Most of them are in continental United States, but some are in Alaska, Hawaii, and Puerto Rico. Six were established primarily as big-game preserves (including a winter refuge for elk in Jackson Hole, Wyo.); one, Nunivak Island, Alaska, for experiments in the propagation and crossing of reindeer and caribou; and one in Alaska for muskrats and beavers. The others are for birds, and the 6 big-game preserves in the United States have been designated as bird refuges also.

BIG-GAME PRESERVES

Continuing the policy established some years ago of preventing overgrazing of the ranges, surplus big-game animals were removed from the four Biological Survey preserves where fenced herds are maintained. The numbers of big-game animals on these four preserves and the increase in certain species are given in table 2. The decrease from the previous year is due to the fact that a large number of surplus buffalo and elk were donated to needy Indians of several agencies for use as meat; and, to protect the grazing, more animals than usual were removed from Niobrara Game Preserve, Nebr., where facilities for disposing of them alive were available for the first time.

TABLE 2.—*Animals on fenced big-game preserves maintained by the Bureau of Biological Survey* [1]

Preserve	Buffalo	Elk	Antelope	Mountain sheep	Deer		Total [2]	Young born in calendar year 1932 [3]		
					White-tailed	Mule		Buffalo	Antelope	Mountain sheep
National Bison Range, Mont.	544	[4] 96	-------	44	[4] 19	[4] 84	787	125	-------	15
Wind Cave Game Preserve, S.Dak.	235	[4] 41	[4] 54	-------	2	[4] 18	350	47	14	-------
Niobrara Game Preserve, Nebr.	126	58	12	-------	2	1	199	38	5	-------
Sullys Hill Game Preserve, N.Dak.	20	[4] 36	-------	-------	7	------	63	4	-------	-------
Total	925	[4] 231	[4] 66	44	[4] 30	[4] 103	1,399	214	19	15

[1] With the exception of young born, figures are for June 30, 1933.
[2] Including estimates.
[3] Young of elk and deer omitted; only estimates could be made.
[4] Estimated.

NATIONAL BISON RANGE

The herds of big-game animals on the National Bison Range, Mont., are in excellent condition this year, and unusually heavy rainfall has put the range in good shape. In line with the Bureau's policy of preventing overgrazing of the range, 89 buffalo, 86 elk, and 7 mule deer were removed from this preserve last fall and winter. Three of the buffalo were sold, and 30 of the elk were furnished for stocking an area in Mount Rainier National Park, Wash.; the remainder were killed on the range and donated for use as meat to Indians of the Blackfeet and Flathead Agencies.

Increases in the herds this season included 73 buffalo calves and 13 mountain sheep lambs, but 5 of the latter were destroyed by eagles. An object of much interest in the buffalo herd is an albino calf, born in May. So rare is an albino buffalo that this one has increased the number of visitors to the preserve.

Improvements on the range included a house for storage of fire equipment necessary for the headquarters buildings, and 15 wooden water tanks, which, in addition to 10 of concrete previously constructed, greatly aid in conserving the water supply for the animals in various parts of the range. An adequate supply of fresh water is necessary to reduce the possibility of any infection of the animals from stagnant, impure water.

WIND CAVE NATIONAL GAME PRESERVE

A rather severe winter was experienced at the Wind Cave National Game Preserve, S.Dak., but the buffalo, elk, antelope, and deer came through in excellent condition. Coyotes drifted onto this preserve in considerable numbers last fall, and a trapper of the Survey established headquarters there early in November. During the ensuing 6 months he took 39 coyotes and 3 bobcats. Various improvements and repairs have been completed, including road improvements and the installation of a steam-heating plant at headquarters.

Forty-three buffalo calves were born at this preserve this season, and 2 young buffalo were disposed of for exhibition purposes last fall. In the summer of 1932, 30 nesting species of insectivorous birds were identified on this preserve. Seven species are resident, and others spend the greater part of the year in the hills.

ELK REFUGE

The hay crop harvested at the Elk Refuge, in Jackson Hole, Wyo., in the summer of 1932, totaled 1,290 tons; 46 tons of this were destroyed by fire caused by lightning. Forty acres of oats grown and harvested on the refuge yielded 1,800 bushels of threshed grain and furnished a considerable quantity of straw for feeding to the elk.

The elk began to arrive at the refuge early in October, and by the time the hunting season closed on November 15 there were approximately 4,000 gathered on the refuge and on the nearby foothills. By the first of the year snow began to accumulate, and the elk were fed from January 6 until April 16. During this period approximately 2,200 tons of hay and 100 tons of cottonseed cake were consumed. About 250 tons of hay remain on hand for next winter, and the State game department also has left 116 tons of hay and 75 tons of cottonseed cake. But some concern is felt from the fact that at the close of the fiscal year the hay and grain crops were less promising than last year, and the State and Federal funds available for purchase of hay had been reduced.

In March a count of the elk on all the feeding grounds, made in cooperation with the State game department and the Forest Service, revealed a total of 11,239 on the 3 refuge feeding grounds and on the 3 maintained by the State. This exceeded by about 1,250 the number of elk fed on these areas in any previous winter. In addition, the State game department fed approximately 300 elk on a ranch about 35 miles to the north. The greater number of the elk came through the winter in fairly good condition; the losses were estimated at slightly over 600 animals. As a large number did not follow their old habit of migrating from the refuge toward their summer range with the disappearance of snow, it was necessary to make three drives to force the animals to leave the refuge and adjoining ranches, and it was not until the first week in June that they finally disappeared for the summer season.

Improvements at the refuge included the construction of 2 bridges, 1 across Flat Creek near headquarters, the other across a large spring; and the erection of 1½ miles of new fence.

NIOBRARA GAME PRESERVE

Twenty-four buffalo calves were born at the Niobrara Game Preserve, Nebr., during the fiscal year, and all survived in strong and healthy condition. In the summer of 1932 temporary fences were constructed across the Niobrara River to connect the north pasture with an enclosed new pasture on the south side of the river where corrals had been constructed. This improvement made it possible to move the animals across and for the first time to capture buffalo and elk alive for disposal. In all previous disposals of the surplus animals at this place, it was necessary to butcher them for use as meat. Of the 41 buffalo and 45 elk removed from this area during the season, 13 buffalo and 30 elk were furnished to parks and State game preserves for exhibition and propagation and 3 elk were sold for propagation. The other animals were disposed of for use as meat. Of these, 21 buffalo and 3 elk were donated to the Indians of the Rosebud Agency, S.Dak.

Late in November the buffalo were rounded up and driven across the river to the new south pasture because of shortage of winter forage in the old pasture, but

the action proved disastrous, as on January 2, 26 buffalo were drowned by breaking through the ice when attempting to recross the Niobrara River. Accustomed to crossing over ice in creek bottoms in their old pasture, the animals apparently had no fear of the ice on the river. While in some places the ice was sufficiently thick to support them, unfortunately they selected a crossing place where it was thin and near an open channel. Nine were salvaged and pronounced fit for food by a veterinarian of the Bureau of Animal Industry and were included in the number donated to the Indians of the Rosebud Agency.

In addition to the buffalo and the elk, which also were driven from the old pasture into the corrals last fall, there are 12 antelope and 3 deer on the preserve.

Approximately 1,200 tons of surplus hay were harvested under permit in the area outside the big-game pastures by nearby ranchers, who were in need of the feed for their stock.

SULLYS HILL NATIONAL GAME PRESERVE

The big-game animals are in good condition on the Sullys Hill National Game Preserve, N. Dak., and the herds were increased by the birth of 3 buffalo calves and about 8 elk calves. One buffalo and 2 elk, surplus in the herds, were disposed of as meat. The last antelope on the preserve died in June, and it is apparent that the area is not suitable for the maintenance of these animals.

CHARLES SHELDON WILD LIFE REFUGE

Drought conditions that prevailed over the Charles Sheldon Wild Life Refuge and the surrounding area in Nevada at the close of the fiscal year are adversely affecting all forms of the wild life. While there was no marked increase in the numbers of antelope during the past year, the drought situation will probably increase the number using the refuge until the first heavy snowfall starts their seasonal migration. Peak numbers during the October-November concentration were estimated at between 1,500 and 2,000, with approximately 1,000 within the borders of the refuge at the close of the year. Although extremely cold weather prevailed over the winter ranges in December and January, the forage was not snow covered, and the antelope wintered without abnormal winter kill. They returned to the refuge in good condition, and the 1933 fawn crop was excellent. The mule deer also wintered well and are increasing rapidly on the refuge. After a decided decrease in the number of sage grouse there in 1931 and 1932, a slight increase was apparent this season, with the hens rearing larger broods.

BIRD REFUGES

NEW REFUGES ESTABLISHED

Two new wild-life refuges, chiefly for the protection of migratory birds, were placed under the jurisdiction of the Bureau of Biological Survey during the year. These were the Boulder Canyon Wild Life Refuge, in Arizona and Nevada, covering about 620,000 acres, approximately 132,000 of which will be the vast artificial lake created by the Boulder Dam on the Colorado River; and the Widows Island Migratory Bird Refuge of 12 acres, in Maine, formerly a naval reservation and transferred to the Department of Agriculture by the Navy Department under act of Congress approved December 22, 1932.

BIG LAKE BIRD REFUGE

In November 1932 it was estimated that approximately 30,000 ducks and coots were on the Big Lake Bird Refuge, Ark. High water from January to March made the waterfowl feeding grounds unsatisfactory, but hundreds of ducks stopped at the refuge in the spring and stayed until May. There is a good showing of wood ducks and hooded mergansers on the refuge, and these species have nested and raised broods of young. To help maintain the lake level at periods of low water, a dam was constructed last summer in one of the outlets of the main body in the southwestern part of the refuge.

LAKE MALHEUR BIRD REFUGE

The fall migration of ducks at the Lake Malheur Bird Refuge, Oreg., showed a heavy increase over 1931 but a decided decrease from years of high water. Nesting conditions for the Canada geese were better than usual in this locality and resulted in a good hatch of young, though much under the average for high-water years. Banding operations were carried on at the refuge, and a few ducks and geese were fed there during the winter.

The question of water rights in the flow of the Blitzen River is still pending in State court, the settlement of which is of vital importance to the maintenance of an adequate water supply for birds at Lake Malheur. This river is the principal source of supply for this important refuge.

UPPER KLAMATH WILD LIFE REFUGE

In December approximately 3,000 ruddy ducks, a few of other varieties, and about 500 horned and eared grebes were ice-bound in the lake at the Upper Klamath Wild Life Refuge, Oreg. The protector of the refuge, with about 25 volunteer helpers, spent 2 days in rescue work, and as a result saved about 1,200 of the ducks and 100 of the horned and eared grebes, and transported them to recovery pens at the refuge headquarters. Dead birds taken from the ice and still useful for food were turned over to charitable organizations.

BLACKWATER MIGRATORY BIRD REFUGE

Experimental work was performed in connection with the introduction of new duck-food plants on the Blackwater Migratory Bird Refuge, Md., and a study was made of the waterfowl. A census of the muskrats was taken, and other data relating to these animals were recorded. As a result of cooperation with owners of adjoining marsh land in burning out the boundary lines, few fires reached the refuge and only a small area was burned over.

Improvement work during the year included repairs to the headquarters house, erection of a fence to prevent livestock damage, and construction of a small wharf, garage, and tool shed.

Recent State legislation forbidding hunting within 100 yards of the refuge boundary will afford the area much additional protection.

CAPE ROMAIN MIGRATORY BIRD REFUGE

Thousands of ducks concentrated on and in the vicinity of the Cape Romain Migratory Bird Refuge, S.C., in December, and by January it was estimated that there were from 20,000 to 40,000 ducks in the district, mostly mallards, with black ducks, scaups, pintails, and many teal. A wild-life survey of the refuge revealed 42 species of birds. The number of breeding pelicans was double that of last year. After the spring storm tides had swept over the nesting grounds, destroying nests and eggs, the pelicans built again, but high tides early in June again destroyed the nests, and the birds finally deserted the area, though a few remained on a part of the refuge. The royal tern colony this year numbered about 12,000 birds, and last summer about 1,200 of these birds were banded on the refuge. A great many least terns were nesting on the area this year. Each year, from May until the middle of August, on high tides at night great sea turtles crawl out on the beaches of the refuge and lay their eggs. The number of turtle nests, on the part of the refuge frequented, was estimated at from 500 to 700, with a total of more than 75,000 eggs. From 15 to 20 percent are said to be destroyed by sand crabs.

CRESCENT LAKE MIGRATORY BIRD REFUGE

Almost a 100 percent increase was observed in the number of birds on the Crescent Lake Migratory Bird Refuge, Nebr., over last year, and on June 30 it was estimated that the number of young waterfowl would be 80 to 100 percent greater than in 1932. Blue-winged teal were the principal nesting birds among the ducks, with smaller numbers of pintails, mallards, gadwalls, and ruddy, redhead, shoveler, and baldpate ducks. Some canvasbacks that remained on the refuge during the summer did not appear to be nesting. Long-billed curlews have shown a decided increase over last year.

Spring rains brought water levels in the lakes within the refuge to a point higher than in 1932, but subsequent lack of rain has lowered them rapidly. Muskrats have been increasing in numbers since the lakes now in the refuge have been closed to general trapping. Five lakes were opened to trapping under permit during the spring, and 484 muskrats were taken by the permittees.

During the year an important purchase was completed of a 2,000-acre tract that joins the two divisions of the refuge. Recreational areas were set aside on Crane, Island, and Hackberry Lakes, which are among the most popular fishing resorts in western Nebraska. The designation of the fishing and other recreational areas has been favorably accepted by the people of the locality. Some 800 trees were planted at the Island Lake recreational area last spring, through the cooperation of the Oshkosh (Nebr.) Chamber of Commerce and the Boy Scouts;

about 800 additional trees were planted around headquarters; a fence was erected to keep cattle from a camp ground; and a combination garage, workshop, and coal shed was built.

ST. MARKS MIGRATORY BIRD REFUGE

The most notable bird wintering on the St. Marks Migratory Bird Refuge, Fla., is the Canada goose, and during the winter of 1932–33 it is estimated that about 3,000 were present. The birds next in abundance were scaups, though black ducks were fairly numerous and canvasbacks were there in considerable numbers. Other species of ducks are found on this area, as well as shore birds, gulls, bobwhites, doves, turkeys, and a few birds of prey. Deer are somewhat plentiful, and last fall were abundant. Among the improvements completed on the refuge may be mentioned the headquarters house, a barn, fences, and a wharf. A boat was acquired for patrol purposes.

UPPER MISSISSIPPI RIVER WILD LIFE AND FISH REFUGE

Areas closed to hunting and trapping during the year on the Upper Mississippi River Wild Life and Fish Refuge were approximately the same as last year. Some additions were made where acquisitions made it possible to straighten and make use of natural boundaries, such as waterways, agricultural lands, and fence lines.

Development of the 9-foot channel on the upper Mississippi River is progressing, and two locks are now under construction, one at Alma, Wis., the other near Whitman Station, Minn., and the indications are that the work will be so expedited on other dams that the entire project will be completed in less than 5 years. One effect of the Alma Dam will be to stabilize the water level on several thousand acres, and thus materially to increase the value of the refuge to waterfowl and muskrats. Most of the land behind the Whitman Dam is owned by the Winona Park board, and there is no prospect of its affecting much of the refuge.

During the year crews of surveyors identified practically all refuge land along the west shore of the Mississippi from Lansing, Iowa, north to La Crescent, Minn., and a considerable area in La Crosse County, Wis. All lands surveyed were appropriately posted, and many of the boundaries were cleared of timber and brush to aid in their better identification and to provide firebreaks. As a result, it will be possible to maintain additional closed areas during the year 1933. A large part of the refuge is yet to be surveyed and posted.

Though a very low stage of water prevailed throughout the refuge during 1931 a new low record was established in 1932, many lakes, sloughs, and ponds being too dry during the summer to produce a satisfactory crop of aquatic vegetation as food for waterfowl and fur animals.

Migratory wild fowl were present in about normal numbers. Though there seemed to be an unusually large fall migration of Canada geese, some observers believe that this was merely a concentrated migration over a shorter period than usual. The lower section of the refuge in the vicinity of Bellevue, Iowa, and Savanna, Ill., continued to attract the largest numbers of birds. The concentrations here will be made the subject of more intensive study, since reports prior to last year listed this section as being relatively unattractive. Favorable water stages during the spring migration led many observers to believe that there was a large increase in the number of migrants. The water and food conditions prevailing in the spring of 1933 probably induced the birds to remain for a longer period than usual, and large numbers of pintails and mallards were present.

The only public trapping of fur-bearing animals permitted on the refuge was for minks, from November 15 to March 1, during which 101 trappers reported a take of 202. This limited catch indicates that minks are not overabundant on the refuge. So marked was the scarcity of muskrats, due in part to low water, that it was necessary to refrain from taking even scientific specimens, though these are needed for study in connection with the wild-life management program.

Eighteen fires occurred on the refuge during the year and burned 2,650 acres, a considerable increase over the previous year, both in the number of fires and in the acreage involved, although efficiency in the system of detecting and reporting fires had been increased. A majority of the fires occurred late in the season, beginning in November and lasting into January. In some respects this added materially to the difficulties of control, as roads were in some cases impassable; frozen lakes, streams, and sloughs made it difficult to obtain a supply of water; and the extreme cold weather prevented effective use of pumps. Fair stages of water assisted materially in preventing fires during the autumn of 1932, but with the falling of the river as the season advanced, fires became more prevalent. The small number from February to the end of June is attributable to the fact that there was then a fair stage of water.

Approximately 2,500 trees and 1,000 shrubs were planted this year, under favorable planting conditions, and the survival of new stock has been satisfactory. A recheck of former plantations disclosed that a high percentage of trees survived and have made splendid growth.

Winter feeding of upland birds as well as waterfowl has continued on the refuge. While as much feeding as possible was carried on, the operations were for the most part limited to the immediate vicinity of ranger stations. Waterfowl were fed at strategic points both during the fall and spring migrations. One result of the winter feeding on the refuge was to stimulate similar work by individuals elsewhere, to the great advantage of wild life.

Special-use permits were issued as formerly, and, in addition, through authorization from the Secretary of Agriculture, approximately 200 free-use permits for removal of dead, down, and defective timber were issued to persons unable to purchase fuel. Likewise, by order of the Secretary, deserving persons have been issued free permits authorizing them to use small parcels of suitable land within the refuge for gardens. Each permittee is required to sow some small grain or set out other food-producing plants, to be left unharvested as a source of winter food for wild life.

BEAR RIVER MIGRATORY BIRD REFUGE

On September 26, 1932, the Bear River (Utah) Migratory Bird Refuge was formally established by Presidential proclamation, and regulations for its administration, effective October 1, were issued by the Acting Secretary of Agriculture. The superintendent's headquarters were moved from Ogden to Brigham, Utah. This change has permitted much closer supervision of the refuge and has proved highly satisfactory.

That the refuge is attractive to waterfowl is evidenced by the great concentration there of wild ducks, geese, shore birds, and nongame birds during the past year. This condition is not in any sense an indication of a general increase in waterfowl, but shows that the refuge is attractive to the birds.

The dikes, river-control works, and spillboxes have proved to be satisfactory, and there is no indication that they will not continue to function as planned. The refuge boundaries have been fully posted.

All units produced a good supply of submerged varieties of duck food, and sago pond weed and other food plants continued to show a marked increase. The food supply on Bear River Refuge is sufficient to take care of many more birds than have thus far utilized it.

A serious outbreak of western duck sickness resulted in heavy mortality from August 10 to about November 10. Though most serious outside the refuge, the outbreak also caused a great loss within the boundaries. During the concentration of ducks on their northern flight in the spring of 1933, another outbreak of this sickness occurred, in a mild form, however; there was virtually no mortality. This outbreak cleared up entirely, and at the end of the fiscal year there was no evidence of a recurrence.

Studies made by the Biological Survey have proved definitely that the so-called "duck sickness" is caused by a toxin developed by bacterial activity in some form of organic decay, as discussed in last year's report. It is quite possible that a condition of alkalinity assists the development of the bacteria (*Clostridium botulinum*, type C). The malady, however, is caused not by the bacteria but by the poisons deposited by them. When conditions are such that wild fowl have access to the poison and swallow it with their food, duck sickness results. With the limited present knowledge, no effective remedy has been found other than to flood affected areas with fresh water, and this was one of the objects sought by the establishment of the Bear River Refuge. Past experience in the handling of smaller units of land in the same section by private gun clubs indicates that, though outbreaks of duck sickness may occur for some years following the flooding of an area once dry, these outbreaks will gradually decrease in violence as the poison is washed away and gradually dissipated. Though there may be future outbreaks of duck sickness within the units of the refuge, it is anticipated that these will diminish and eventually cease as the result of continued flooding operations. Unfortunately, however, there is at the present time no way by which this method can be used to prevent duck sickness in the extensive areas outside the refuge, and serious losses from this source must be anticipated unless further study develops some other remedy that will be applicable and efficacious.

In cooperation with the State game commissioner and after consultation with a committee representing the sportsmen of Utah, an open area for public shooting was agreed upon. By order of the Secretary of Agriculture, 13,000 acres representing about 40 percent of the flooded part, were designated as a public shooting ground.

Permanent improvements on the refuge included provision of a headquarters cottage, two guard cabins, a garage and boathouse, and water and gas systems.

REFUGES IMPROVED UNDER EMERGENCY CONSERVATION PROGRAM

On May 29, the President approved the establishment of Civilian Conservation Corps camps at the Blackwater Migratory Bird Refuge, Md., the Swanquarter Migratory Bird Refuge, N.C., and the St. Marks Migratory Bird Refuge, Fla. These refuges were acquired by the Department under the Migratory Bird Conservation Act of 1929 and have been under jurisdiction of the Biological Survey for about 2 years. With the aid of the Conservation Corps, extensive developments at each refuge will include construction of roads, trails, fire lines, and lookout towers, and dams to create fresh-water ponds for wild-fowl food production. These improvements will greatly facilitate the administration of the several areas and materially improve their value in wild-life conservation.

SUPPLEMENTARY REFUGES

The appeal made by the Biological Survey in the spring of 1932 urging that individuals and organizations establish numerous small sanctuaries for migratory birds has met with some response, but not in the measure wished for. There are still many opportunities for attracting waterfowl to sloughs, ponds, and lakes that have great possibilities as areas for wild life but are not of sufficient size to justify administration by the Government. Renewed interest in this effort to supplement the Federal refuges is greatly desired.

An example of what might be done elsewhere is demonstrated in North Dakota, where, through interest in this program, several Civilian Conservation Corps camps have been detailed on water-conservation work, principally the construction of relatively inexpensive dams in stream beds that periodically go dry. Such developments not only improve the ground-water conditions, but also provide for fishing and serve as resting and feeding areas for migratory birds.

ADMINISTRATION OF LAWS FOR WILD-LIFE CONSERVATION

Statutes administered by the Bureau of Biological Survey for the protection of wild life are the Migratory Bird Treaty Act of 1918, protecting birds that migrate between the United States and Canada; the Lacey Act of 1900, pertaining to interstate shipments and importations of wild birds and mammals; laws affecting animal life and property on Federal wild-life refuges; the Migratory Bird Conservation Act of 1929, authorizing establishment and administration of bird refuges; and the Alaska game law of 1925, through the Alaska Game Commission.

UNITED STATES GAME PROTECTORS

At the end of the fiscal year there were 25 United States game protectors in the permanent field force engaged in the administration of the Migratory Bird Treaty Act and the Lacey Act. In view of the efforts being made to reduce the expense of government, it will be necessary during the ensuing fiscal year to reduce this small force still further, and to abandon several enforcement districts until such time as the financial condition of the Government permits resumption of this important work.

The essential importance of regulations to reduce and control the annual kill of ducks has been greatly emphasized during the past few years, during which time the wild fowl have suffered serious losses both from overshooting and from the effects of disastrous and long-continued drought on their principal breeding ranges. At this time, when it is of the utmost importance that a sufficient breeding stock of birds be preserved, it is imperative that the force of United States game protectors be increased sufficiently to obtain reasonable and adequate enforcement of these emergency conservation measures.

The Federal game protectors are not only law-enforcement officers—they are also constantly assisting game conservation in an educational way. In this they were aided by publications of the Department issued during the year (Miscellaneous Publication No. 151 and Service and Regulatory Announcement B.S. 77) on Federal and State game laws (including a poster (no. 51-Bi) on open seasons for game birds), and information issued by the Biological Survey through the press and by radio. In the 1933 Yearbook of Agriculture was published a table (493, p. 753) on hunters' licenses issued by States, with total money returns, for the seasons 1930 and 1931, reprinted separately for correspondence purposes.

MEASURES TO PRESERVE WATERFOWL

At the beginning of the breeding season, water conditions on the most important areas in the northwestern United States and the southwestern Canadian Provinces showed some improvement, and the extensive investigations the Bureau had conducted throughout the year indicated that the reduction of the shooting season in the United States from 3 and 3½ months to 1 month in 1931, and to 2 months in 1932, had been effective in conserving the supply of mature birds during their stay in the United States.

Other amendments made in 1932 placed a continuous closed season on ruddy and bufflehead ducks, reduced the bag limit on mourning doves from 25 to 18 a day, forbade mourning-dove hunting within 100 yards of a baited area, and restricted to 25 the number of live-duck decoys that might legally be used. In the total daily bag of 15 for all ducks the number for certain species was restricted to 10, except for eider ducks, on which the limit was set at 5, in view of the fact that most of these species had not recovered from the effects of the drought that had prevailed on their breeding grounds for several years, and the numbers of others had been materially reduced by the effects of heavy shooting and loss of marsh lands by drainage and other causes.

A fairly satisfactory return migration of mature birds moved northward to the breeding grounds in the spring of 1933. Early reports from Survey investigators in these areas were encouraging with respect to water conditions, and there was some reason to hope that there would be a gradual return to normal in these vast regions, which produce more than half the ducks that migrate to the United States every year. Early in June, however, the observers began to note a general cessation of rainfall throughout the entire zone, and within a few weeks it became apparent that the water conditions were again to be disastrously below normal, with the usual serious consequences to waterfowl. In view of this situation it is obvious that means must be adopted to effect further reductions in the numbers of birds to be taken by the gunners in the United States during the coming season.[1]

Of benefit to the waterfowl that frequent the District of Columbia was an act of Congress of July 14, 1932, which, supplementing existing laws, converted the whole area into a wild-life sanctuary by making it unlawful to hunt or needlessly disturb wild ducks and other waterfowl on any of the waters of the District.

The advisory board, Migratory Bird Treaty Act, was reorganized during the year, with a membership of 23. For the first time in the history of the board, which was established for the purpose of advising the Secretary on matters connected with the adoption of wild-fowl hunting regulations, a woman was appointed to membership—Mrs. William L. Wilson, chairman of the division of conservation of natural resources of the General Federation of Women's Clubs. The first meeting of the new board was planned for early in July, to consider the wild-fowl situation and to discuss measures that might be the most efficacious in the present emergency.

In connection with restrictions that have been or may be placed upon the gunners in the shooting of waterfowl, it is desirable to restate a fundamental principle of game conservation—that the waterfowl-refuge system is wholly inadequate alone to preserve a sufficient breeding stock during an emergency of a nature similar to that which has prevailed during the past few years. The sole effective means by which a sufficient supply can be saved is greatly to reduce the total number of birds annually killed by gunners during the open season. This result can be attained only by restrictive regulations, adequately enforced, generally observed, and respected by the gunners themselves.

LAW VIOLATIONS AND PENALTIES

MIGRATORY BIRD TREATY ACT CASES

The number of cases of violations of the Migratory Bird Treaty Act reported by the Department for prosecution was slightly less than during the preceding year. The number of convictions obtained also showed a slight decrease, but there was an increase in the fines imposed. Disposition of the cases is shown in table 3. Action was not recommended in 105 cases, on account of lack of evidence, youthfulness of the accused, or other satisfactory reasons. Fines and costs ranging from $1 to $1,800 and aggregating $8,329.53 were imposed by the Federal courts. Jail sentences were imposed as follows: 1 to 20 days, 6; 30 days, 8; 60

[1] Amended regulations approved by the President on Sept. 11, 1933, although retaining the 2-month seasons on waterfowl, reduced the daily bag limits from 15 to 12 (on certain ducks from 10 to 8) and closed the season on brant in the Atlantic Coast States.

days, 1; 90 days, 2; and 18 months, 1. Sentences were suspended in 4 cases for 5 years each, and in 9 other cases for 30, 60, 90, or 180 days, and in 45 cases the offenders were placed on probation for periods ranging from 6 months to 5 years. Three cases tried before a jury resulted in verdicts of guilty. Seizures of migratory game birds had an estimated value of $1,000. Such birds as could be utilized for food were donated to hospitals and other public charitable institutions.

TABLE 3.—*Cases of violation of the Migratory Bird Treaty Act disposed of during the fiscal year and cases still pending June 30, 1933*

Cases disposed of	Number	Cases pending	Number
Convictions	279	Pending from former year	366
Dismissals	35	New cases	352
Verdicts of not guilty	11		
No bills found	5	Total	718
Nol-prossed	25	Disposed of	374
Death of accused	1		
Denied leave to file	3	Pending at end of year	344
Closed without prosecution	15		
Total	374		

Outstanding cases during the year were as follows: For killing swans, 3 violators in Maryland were given suspended jail sentences of 6 months and suspended fines of $500 each, and were placed on probation for 1 year. One case in Kentucky, involving the sale of wild ducks, was terminated by a fine of $100 and a 2-month jail sentence. One case of hunting geese with an airplane in Illinois was disposed of by a $5 fine. One case in Tennessee, involving the illegal interstate transportation of live quail, resulted in a fine of $1,800 and a jail sentence of 18 months, to stand suspended on payment of the fine; this defendant, fighting removal from Texas to Tennessee for trial, sought release on a writ of habeas corpus, and when this was denied he appealed to the United States Circuit Court of Appeals for the Fifth Circuit, which sustained the action of the lower court in remanding him to custody of the marshal; a petition to the United States Supreme Court for a writ of certiorari was then denied.

Other cases that may be mentioned of violation of the Migratory Bird Treaty Act, successfully terminated during the year included trapping ducks, 2 (Virginia); hunting ducks on the first day of the open season prior to noon, 4 (3 in California and 1 in Texas); killing ducks in excess of the daily bag limit, 8 (6 in California and 2 in Louisiana); killing ruddy ducks, 1 (California); shooting over more than 25 live-duck decoys, 4 (2 each in Missouri and Louisiana); and killing doves over baited fields, 15 (Georgia).

UPPER MISSISSIPPI RIVER REFUGE CASES

Thirteen new cases involving violations of the Upper Mississippi River Wild Life and Fish Refuge Act were submitted for prosecution during the year. Of these 9 are pending; 3 were disposed of by fines totaling $50, and 1 by a 30-day jail sentence. In addition, 4 cases previously reported were terminated, 2 by fines of $10 each; 1 by a suspended jail sentence of 90 days, the defendant being placed on probation for 3 years; and in 1, the defendant, upon plea of guilty, was placed on 18 months' probation.

Thirty-one persons apprehended on the refuge by reservation rangers for violating State game and fish laws were proceeded against in State court, where 3 were dismissed, 12 received jail sentences of 3 to 60 days, 2 were paroled for 1 year, 6 received suspended sentences on payment of costs, and 8 paid fines and costs totaling $482.

INTERSTATE SHIPMENTS OF WILD BIRDS AND MAMMALS

In extensive investigations under the Lacey Act, which seeks to lessen interstate shipments of wild birds and mammals made in violation of State law, United States game protectors discovered a number of infractions of State game laws with reference to traffic in pelts of fur-bearing animals. Evidence of apparent illegal shipments of game animals also was developed through these investigations.

As a result of inspections made at raw-fur receiving centers, information regarding 4,300 shipments that apparently contained skins illegally taken or shipped was transmitted to the State game departments. The several States closed during the year 150 cases based on information originally furnished by the Survey, in

which the aggregate of fines and costs was $11,591. In 578 other investigations by the States on information furnished by the Survey, it was found that the shipments were lawfully made or that for certain reasons State prosecution was undesirable.

Evidence in connection with 421 violations of State game laws, involving all classes of offenses other than interstate shipments of skins of fur animals, was furnished to the game departments of 31 States. As a result of prosecutions of these offenders in State courts fines and costs aggregating $11,764.65 were imposed.

PERMITS ISSUED UNDER MIGRATORY BIRD TREATY ACT

The regulations under the Migratory Bird Treaty Act provide for the issuance of permits to take, possess, buy, sell, exchange, and transport migratory waterfowl for propagation; and to take, possess, buy, sell, exchange, and transport migratory game and nongame birds for scientific purposes. The number of such permits outstanding at the close of the year, including permits issued during the year, was as follows: Scientific collecting, 2,305; scientific possession, including taxidermist, 548; special scientific possession, 1,394; bird banding, 1,671; and propagating (possession and sale), 4,560.

Ninety-five permits to take migratory waterfowl for propagation also were issued. Reports submitted by permit holders covering operations thereunder during the calendar year 1932 show 63,951 wild ducks raised in captivity, of which 61,197 were mallards and 1,947 black ducks, and the others mainly wood ducks, pintails, teals, gadwalls, canvasbacks, bluebills, shovelers, baldpates, and redheads. The number of wild geese raised was 4,381. Migratory birds propagated and reported sold during the year included 7,868 ducks and 218 geese for food, and 7,391 ducks and 2,951 geese for propagation.

FOREIGN IMPORTATIONS UNDER LACEY ACT

The close of the fiscal year marks the completion of 33 years of regulation of importation of species of foreign birds and mammals. During this time approximately 12,000,000 birds and many thousands of mammals have been brought in under some 20,500 permits. During all this time so far as known not a single injurious species has gained a foothold in continental United States.

Regulations issued by the Secretary of the Treasury and enforced by the Customs Service, governing the importation of foreign wild animals and birds into the United States under permits of the Secretary of Agriculture, were codified, amended, and published during the year. In order to insure more effective protection against the entry of injurious species some changes were made, including the requirement of a permit for each shipment of mammals, whether it contains one or several specimens. Heretofore not to exceed five mammals or birds might be brought in under a passenger's baggage declaration without a permit, and through this loophole doubtless some prohibited species gained entrance which otherwise would not have been admitted. The exemption of five now applies only to parrots and canaries accompanied by the owner. To guard against the introduction of the mongoose, the mynah, and other injurious species from Hawaii, permits are now required for the entry of each shipment from Honolulu to San Francisco, Los Angeles, or other Pacific-coast ports. Attention has been called to the fact that the immediate transportation provisions of the tariff act are subordinate to those of the Lacey Act, so that all species must be entered at the border before proceeding to destination under bond. Thus, birds consigned to Chicago, St. Louis, or other interior ports must be entered at New York, Philadelphia, or some coastal port without the privilege of being entered at destination. Provision has been made for increased inspection at Pacific-coast ports through cooperation with the Bureau of Plant Quarantine and the appointment of additional inspectors at Los Angeles and San Diego.

On account of the general depression the number of foreign birds imported was less than that of the previous year. This is particularly noticeable in the case of quail, in which the reduction was nearly 50 percent.

The number of importation permits issued during the year was 912, of which 32 were unused and canceled, a decrease of 238 from 1932. Shipments inspected decreased from 407 to 267. Nineteen additional permits were issued at Honolulu, Hawaii, for the entry of 147 miscellaneous birds. The total number of all foreign birds imported was 311,036. This was less than half the number brought in during 1930, the high-water mark of importations, when 825,736 were entered. Of the total number of birds brought in in 1933, 2,283 were entered without permit, many of them brought in under declaration of passengers' baggage. Included in the total were 261,633 canaries, 1,217 parrots, 22,110 Mexican quail, 6,021 Hungarian partridges, and 20,055 miscellaneous birds.

PROHIBITED SPECIES

No prohibited species were entered during the year, but on April 14 a report was received that a miscellaneous collection of mammals carried by an expedition returning from the Tropics to San Diego contained a mongoose. Upon receipt of the notice the captain of the vessel was advised that the animal could not be admitted even though castrated, and accordingly it was put ashore at Acapulco, Mexico.

BEARS

The importation of black-bear cubs from Canada continued with only a slight decrease from previous years. Permits were issued for the entry of 83 separate shipments containing a total of 174 cubs, as compared with 190 in 1932. Most of the bears were brought to New Jersey, a few to other States.

ANTHROPOID APES AND MONKEYS

The records of the year were marked by the entry of two gorillas, one of which came from West Africa in August, and the second, a young animal captured in Kribi, French Cameroons, was shipped from Freetown, Sierra Leone, in January. Considerable correspondence developed in regard to the latter gorilla, which lacked the credentials necessary for the issuance of an importation permit. The animal was allowed to land under bond, but formal entry was not completed until the necessary authorizations and consular certificate had been obtained, 3 months after arrival.

As usual, monkeys in considerable variety were brought in, rhesus monkeys alone numbering 2,686. The list comprised several interesting species including baboons, langur gibbons, colobus monkeys, and pig-tailed macaques from the Old World, and lion-headed and woolly monkeys, white-necked and white-faced marmosets, and Oersted's titi monkeys, from tropical America. Many of these animals are brought in as pets by passengers, and under the new customs regulations a permit was necessary in each case.

MEXICAN QUAIL

Judging by the permits issued to export quail from Mexico, extensive preparations were made by shippers last spring, but the depression in the United States and the restricted market for the birds greatly reduced the numbers actually brought in, the total being 22,110, as compared with 39,131 last year. The importations this year were the smallest in a decade; only 9,123 were imported in 1923. No evidence of quail disease was apparent, and the reduced entries were due entirely to economic conditions. No quail were entered at Brownsville, and the entries at Laredo and Eagle Pass were distributed mainly to four States: Kansas, 8,717; Tennessee, 6,000; Texas, 4,099; and Kentucky, 2,500. The other birds, numbering nearly 800, were distributed in small lots to 16 States—Arizona, Arkansas, California, Delaware, Florida, Georgia, Louisiana, Massachusetts, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, South Carolina, and Washington.

The total number brought in since 1910 is approximately 714,000.

HUNGARIAN PARTRIDGES

Entries of Hungarian partridges for the year numbered 6,021, a decrease of 595 from last year. Widespread interest has developed in the introduction of these birds, but lack of funds for purchases by game commissions and associations and the difficulty of procuring stock in some European countries militated against large importations. During the 20 years in which the main importations have been made, somewhat less than 300,000 birds have been introduced, but in the meantime the species has become acclimated in several of the Western States, notably Wisconsin, South Dakota, and Washington.

CAGE BIRDS

Importations of canaries and other cage birds show a considerable decline, in spite of efforts to stimulate the trade during the holidays by sales at popular prices. The total number of canaries imported was 261,633.

Parrots and parrakeets show a decided decrease. Because of the recurrence of parrot fever in California and also at some points in the Eastern States, quarantine regulations were made more drastic, especially on the Pacific coast, and consequently comparatively few birds were imported. Under the revised regulations of the Public Health Service a certificate from the health authorities in the place of origin must accompany shipments of more than five birds, certifying as to the condition both of the birds and of the aviary or other distributing establishment from which shipped. A health certificate from State authorities is also required for interstate shipments of parrots.

RARE BIRDS

Among the rare birds imported during the year were 4 elegant parrakeets (*Neophema elegans*), an Australian species now in danger of extinction; 1 black cockatoo (*Probosciger aterrimus*), from Singapore; 6 black-footed penguins (*Spheniscus demersus*) from South Africa; 2 flightless cormorants (*Nannopterum harrisi*) and 4 Galapagos penguins (*Spheniscus mendiculus*) from the Galapagos Islands; 1 shoebill (*Balaeniceps rex*), 2 saddle-billed storks (*Epihippiorhynchus senegalensis*), and 8 bustards (*Houbara undulata*), from Port Said, Egypt; 2 Dow's tanagers (*Tangara dowi*), from Costa Rica; and 2 red-headed tanagers (*T. cayana*), 3 Desmarest's tanagers (*T. desmaresti*), 1 black-headed tanager (*T. atricapilla*), and 8 black-and-green tanagers (*T. nigriviridis*), from Venezuela.

CONSERVATION OF ALASKAN WILD LIFE

The principal amendments to the regulations for the 1933–34 season under the Alaska Game Law, published in April, afford greater protection for large brown and grizzly bears and moose and modify the trapping restrictions. Some of the recommendations of the Special Senate Committee on the Conservation of Wild Life Resources, notably those relating to the conservation of the large brown and grizzly bears, were incorporated in the revised regulations and other protective measures. This committee had issued a report in March 1932 on its study of conditions affecting this valuable resource of the Territory, in which special attention was given to methods and means of perpetuating the supply of big-game and fur animals.

As a result of appeals from interested conservationists, additional protection to large bears of several closely related species was afforded by extending the limits of an inviolate sanctuary where these superb carnivores may roam unmolested. The added sanctuary area embraces 1,910 square miles adjacent to and supplementing the Glacier Bay National Monument. The boundaries of the recently closed area follow closely those suggested for a national park in this region, and the combined closed area, including the monument, where the bears are now fully protected, contains approximately 3,730 square miles.

The amended regulations give further protection to large brown and grizzly bears by closing the season from June 20 to September 1 throughout the coastal ranges. In this region the seasonal bag for residents and nonresidents alike is restricted to two. The amendment safeguards the bears against unwarranted killing in summer, when their pelts are valueless for trophies.

Because of an unusual volume of publicity regarding the bears, an increasing number of people are apparently planning trips to the Territory to obtain trophies or to photograph the animals in their native haunts. For the safety of the uninitiated the regulation requiring that photographers, as well as hunters, be accompanied by registered guides has been clarified and continued in force.

Further protection of large brown and grizzly bears on Admiralty Island is contemplated in a game-management plan partly worked out by the Alaska Game Commission, the Forest Service, and the Bureau of Biological Survey during the year, to coordinate timber operations and bear protection. In connection with the development of this plan the Alaska Game Commission cooperated in taking a census of bears on the island, which resulted in much valuable information. The estimated aggregate population of the five species on this area is now 900.

Moose are afforded additional protection in southeastern Alaska by an amendment to the regulations that prohibits shooting on certain coastal islands, on which these animals take refuge during the breeding season. To provide a practical, well-defined boundary of the Kenai Moose Refuge, a part of the eastern side is made to follow natural watersheds and streams.

The Big Delta closed area for the protection of introduced buffalo was slightly reduced in response to appeals from local sportsmen. Without lessening protection to the buffalo, this will permit other uses of the area eliminated.

Few changes were made in regulations respecting fur-bearing animals, the principal one providing an extension of the open season on beaver to May 10 except in districts 1, 3, and 8, where no season was provided. Adverse economic conditions, with declining fur prices, have affected many of the trappers in the Territory. Trapping restrictions were therefore liberalized to afford residents the maximum benefits consistent with proper maintenance of the breeding stocks of the various species.

U. S. GOVERNMENT PRINTING OFFICE: 1933

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REPORT OF THE CHIEF OF THE BUREAU OF CHEMISTRY AND SOILS, 1933

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY AND SOILS,
Washington, D.C., August 31, 1933.

SIR: I present herewith the report of the Bureau of Chemistry and Soils for the fiscal year ended June 30, 1933.

Respectfully,

HENRY G. KNIGHT,
Chief of Bureau.

Hon. HENRY C. WALLACE,
Secretary of Agriculture.

INTRODUCTION

The vital problems of agriculture change from one era to another. Any program of scientific research in behalf of agriculture must be based upon a clear comprehension of present needs and economic trends. Although there are some phases of the agricultural situation in which the physical sciences can be of little or no assistance, there are important problems to the solution of which they alone hold the key. It is of the highest importance that all scientific agricultural research, both State and Federal, be directed to basic agricultural requirements and that such research be coordinated with the economic corrective measures that are now being instituted.

In the progress of civilization based on the scientific conquest of nature, the world pauses at intervals to learn better how to use the facilities that science and invention have provided and to correct economic and social maladjustments in order that the fruits of this conquest may be distributed more uniformly throughout the social body. Under such conditions less emphasis is placed on man's relation to nature, and far greater stress is placed on man's relation to man. This is our present situation in economic depression.

This condition creates the illusion that man has acquired too great a mastery of nature for his own good. In the hysteria of the moment it is even proposed to declare a moratorium on scientific research because of the assertion that it has been responsible for overproduction. Historical perspective is needed in considering the matter. Not less, but more, research is required, but it must be brought to bear in some new directions and with a sense of the strategy dictated by economic and social considerations. Discriminating direction of scientific research and increased perception of economic and social needs are imperative. Scientific effort must harmonize more closely with the growth requirements of a balanced industrial structure. It is fitting that the initiative in this direction be taken by Government-sponsored scientific research.

A phase of recovery from former economic depressions has been the creation of additional wealth in the form of new agricultural areas, the building of railways and the general commercial development associated therewith. Conquest of physical frontiers and the pioneering involved therein are largely a memory of the past. The frontiers of the future are those of the mind, and both economic research and scientific effort must assume increased importance as the complexity of the social and industrial structure inevitably increases.

Agricultural scientific research is not associated exclusively with increased production, as many suppose, but it can be applied to conserve agricultural cap-

ital, to reduce cost of production, and to promote increased utilization and consumption of farm products. Achievements along these lines can be immediately and directly applied in a constructive manner to meet present needs. This is the basis of the work of the Bureau of Chemistry and Soils.

The research program of the Bureau harmonizes with and supplements the purpose of the Agricultural Adjustment Act. It has definite, constructive value in promoting agricultural recovery. This may be seen from the following general discussion of the economic significance of the work of the three administrative units of the Bureau, and from the subsequent more detailed account of the progress made by each unit during the past fiscal year.

CHEMICAL AND TECHNOLOGICAL RESEARCH

Agricultural research has heretofore been almost wholly occupied with the problems of production. The time is now at hand when much greater stress in scientific and inventive accomplishment must be placed upon more extensive and more profitable utilization of farm commodities, the development of new products and the opening of new markets.

It has not been sufficiently realized that scientific research is capable of influencing materially the channels of use and distribution of farm products. That this is true is self-evident when one considers that research and invention have already had a tremendous influence in molding and shaping the existing industrial and commercial organization for the processing and utilization of farm products, which is now studied in statu quo by market specialists.

Progressive manufacturing industry has not been content to allow its markets to remain in a static condition. Our great industrial corporations have been depending, to a continually increasing extent, upon their research departments to devise new or improved products, thus providing the necessary flexibility to combat adverse conditions and to develop new markets and stimulate old markets. In discussions of present economic problems much has been said regarding the possible influence of new products and of new industries in providing a stimulus to business and in increasing employment.

The work of the scientist is indispensable to unlock the door to these potential markets and must be accomplished before the market specialist can function. Agriculture may well demand that those principles which have been so well utilized by the manufacturing industry be applied also for its benefit. Expansion of markets in this manner should go hand in hand with measures designed to control production in relation to consumption demand.

With the multiplication of manufacturing processes and the great increase in secondary and tertiary products derived from raw materials, the course of agricultural commodities through the channels of distribution, processing, and manufacture prior to consumption is continually becoming more involved and complicated. The farmer stands at one end of this line and the ultimate consumer at the other. A complete visualization of this industrial picture, not only from the marketing standpoint but also from the standpoint of the technological processes and the scientific factors involved, is indispensable both for the control of production in relation to consumption and for the development of new uses and new market outlets for agricultural materials.

The interest of the farmer cannot terminate with the production of his crops. He is necessarily concerned with the manner of their utilization, the trend of existing markets, and the possibility of developing new uses and new markets, particularly for surplus, culls, and waste. In fact, no one is as vitally interested in this matter as is the farmer, for it is his products which seek a buyer. Hence, the initiative in such developments must usually fall upon him or upon State or Federal agencies acting in his behalf. After the necessary initial research has been done, further developments can be effected through ordinary commercial channels.

It is therefore important to have in the Department of Agriculture a scientific and technological agency which is in a position to visualize the flow of farm products through the various industrial processes for which they serve as raw materials and which, with this background in view, can increase marketability and devise new uses and new market outlets for farm surplus, culls, and waste, with resulting increase in crop diversification. The Chemical and Technological Research Unit of the Bureau performs such a function.

The economic significance of the work of this unit is indicated in the following discussion of its various phases.

IMPROVEMENT IN QUALITY AND BETTER ADAPTATION TO MARKET REQUIREMENTS AND PREFERENCES

Economic maladjustments in the marketing and distribution of farm products are frequently caused by physical, as well as human, factors and these can be corrected by scientific research. In many cases better marketability would result if quality were such as to conform more closely to market requirements and preferences. This can usually be attained at little or no additional production expense. The solution of some scientific or technological problem is usually required to accomplish this end. This work in some cases refers to primary farm products and in other cases to derived commodities produced on the farm. Its nature can be shown better by a few examples than by discussion.

Oranges, lemons, and grapefruit, although sound and mature, are frequently unsalable because they have not developed the color expected by the consumer. By a harmless treatment with ethylene gas, such fruit may be made to develop rapidly the characteristic yellow color. Commercial use of this method has substantially increased the value of the Florida orange crop by making fruit available for an earlier market than would otherwise have been possible. This treatment is also used for hastening development of color in apricots and for softening pears for cannery use.

Farm-made sirups (maple, sugarcane, and sorgo) are a cash crop, valued annually at $17,000,000, on about 450,000 small farms. The bulk of this sirup is marketed. The farm value varies by as much as 300 percent from high grade to low grade. Improvement in production methods resulted in substantially higher prices in 1932 in sections where these methods were used.

The United States produces about 65 percent of the world's supply of naval stores (turpentine, rosin, pine oil, and related products from the pine tree). Improvements in methods of producing rosin resulted in a substantial increase in the proportion of high-grade rosin, with consequent increase in value to producing farmers. The domestic soybean crop has been increasing steadily during recent years and has proved to be valuable for crop diversification. Maintenance of the economic position of the crop and its profitable expansion are dependent on utilization of the oil, which in turn depends upon the production of oil of certain chemical characteristics which make it suitable for technical use.

SUBSTITUTION OF DOMESTIC FOR IMPORTED COMMODITIES

It is not wise to attempt to produce in this country certain crops which are not well suited to domestic agriculture. It must also be recognized that in the international exchange of commodities, a sufficient quantity of goods must be imported to permit payment for exports.

On the other hand, there are a number of products, derived from agricultural commodities, which are now imported into the United States in considerable quantities and which may profitably be replaced by products derived from domestic farm commodities. Such substitutions would fit logically into the scheme of domestic agriculture, would correlate well with existing crops and industries, and would contribute materially to diversification and to farm income.

For instance, an increase in the domestic supply of leather-tanning materials is desirable. Over 90 percent of the heavy leathers are made with vegetable tanning materials. Over 60 percent of the domestic supply of tannin is now derived from the chestnut tree, which will soon be nonexistent because of blight. The other principal vegetable tanning material, quebracho, is imported. Research on western hemlock bark has indicated its value as an additional tanning material.

Another instance of substitution of a domestic for an imported product is the development of an industry which it is anticipated will supply sweetpotato starch to cotton mills in replacement of imported potato starch, thereby providing a market for cull sweetpotatoes which are now largely wasted.

PREVENTING DETERIORATION OF HARVESTED CROPS

Serious deterioration of certain crops occurs with considerable regularity after harvesting. This results either in actual destruction in some cases or in such impairment of quality as greatly to reduce market value. This deteriora-

tion is the more serious because it occurs after full expense of growing and harvesting the crop has been incurred. Production control obviously should start at the source and should not involve erratic destruction or harvested crops. It is estimated that at least one tenth of the harvested hay crop, which had a farm value of $632,000,000 in 1931, is lost by spontaneous heating occurring between the time of cutting and of consumption. The sugarcane crop in the continental United States is subject to great deterioration and loss of sugar during the period between harvesting and grinding, and under certain weather conditions a large part of the harvested crop has been lost. Losses of these two crops can be reduced materially by suitable methods of storage (and also of curing in the case of hay). Work on these problems is under way.

PREVENTION OF FARM FIRES

Farm fires (in farmhouses, barns, and nearby buildings) annually destroy some 3,500 lives and over $100,000,000 worth of property. The latter represents a fire loss equivalent to an annual tax of about $19 on each farm in the United States. Various measures which have been introduced have resulted in a material reduction in these losses. Safety codes for dust-explosion prevention have been developed. In work on the handling of grain, threshing machines have been so improved as to result in direct saving in insurance against dust explosion and fire hazards.

INSECTICIDES

Orderly production and marketing of many crops is impossible without the systematic use of insecticides. Cheaper insecticides are needed in order to reduce production costs. Development of insecticides of greater suitability for specific purposes is a factor of increasing importance, not only in relation to insect control, but also with respect to removal of residues from marketed fruits and vegetables in order to reduce the health hazard. Food-law regulations regarding insecticidal residues are becoming more stringent in both domestic and foreign markets. Chemical washing solutions for removing these residues have been devised. However, a more important result is the development of insecticides which are effective against insects, but are not poisonous to man.

FINDING USES FOR NEW OR EXPANDED MINOR CROPS

The substitution of new crops, or the expansion of minor crops, for which markets are already available is desirable in order to utilize profitably some of the acreage which is withdrawn from staple crops for purposes of production control. In the Bureau's work on this subject, the industrial uses of various derived products obtained from certain crops have been examined in order to find a suitable place in the economic scheme for these new, or expanded, crops and their industrial derivatives. Even though there may be no apparent competition between existing crops and these new, or expanded, crops, their secondary products may be in conflict with the result of definite, adverse effect on price.

In this instance, it is of little economic advantage to "rob Peter to pay Paul." Such additional crops must fit nicely into the economic picture and supply existing needs and deficiencies which are not otherwise filled. Crop rotation and soil suitability are important factors. However, the most urgent consideration is suitable market outlets which do not have an adverse effect on the price of other farm commodities. Such outlets can, in many cases, be created by scientific research directed with understanding of industrial requirements.

Various illustrations of work done by the Bureau in this field will be found in subsequent portions of this report. Among these may be mentioned, particularly, research on greater utilization of the chicory crop and on new, substantial crops of insecticidal plants. It has been found that the wild plant, devil's shoestring, which is common throughout the United States is an important source of rotenone, one of the most powerful contact insecticides known. The new insecticide, neo-nicotine, developed by the Bureau, has recently been found in a Russian weed, *Anabasis aphylla*. Experimental plantings have been started in California. With the development of these crops the farmer will grow insecticidal plants, which will serve the twofold purpose of profitable crops and more suitable insecticides.

The Agricultural Adjustment Administration has recently organized a Replacement Crops Section for the purpose of assisting farmers to shift production from surplus basic crops to other crops so as to obtain a better balance than now exists. The problem of use of the idle land, which has appeared in every State where acreage reduction has taken place or is contemplated, is said to be one of the most important facing the administration.

PROFITABLE UTILIZATION OF FARM SURPLUS, CULLS, AND WASTE

In addition to control of production of farm commodities in relation to consumption, which is to be effected under the guidance of the Agricultural Adjustment Administration, there is a second step which must be taken in order to complete the scheme of properly adjusted production and utilization of farm crops. This second requirement is the intensive utilization of all that is produced on controlled acreage, so as to afford the farmer the maximum return for his investment in labor and soil fertility.

There are two types of agricultural residue. The first consists of the stalks, stems, hulls, cobs, etc., which are necessarily grown in producing marketable portions of crops. Not only are these residues largely unutilized, but a labor cost is incurred before they can be separated from the marketable portions and discarded. Agricultural residue of the second type results from the rejection of culls and off-grade material (principally from fruits and vegetables) in the market grading of farm commodities. It has become recognized that it is more profitable to grade many agricultural products and adjust the price according to grade than to sell the product on a field-run basis at a flat price. The criterion of the extent to which it is profitable to carry the grading of farm products is the net price obtained for total production.

The grading of agricultural commodities, even when justified by a better net price, is the cause of a substantial proportion of culls and off-grade material. Hence, the more profitable utilization of these byproducts is a problem of importance which goes hand in hand with the protection of market quality through application of grading standards. Profitable byproduct utilization of this material serves to support the market grades and makes possible a desirable flexibility of marketing policy. Thus, in years of relatively large production it may be possible to divert more of the crop into byproducts, and in periods of underproduction it may be profitable to sell a greater proportion through the usual market channels. Such diversification of use is particularly important for perishable crops.

This principle has been successfully applied by citrus-fruit growers through the organization of a cooperative byproducts industry, which resulted from research by the Bureau. The citrus-byproducts industry acts as a balance wheel for the citrus crop through its ability to divert surplus fruit into noncompetitive channels. This enterprise is now the world's largest producer of lemon oil, orange oil, and citrus pectin. It is also a large producer of citric acid, which not only supplies the domestic market but is shipped to Europe.

Another instance is the recent development by the Bureau of a process whereby starch of fine quality can be produced from cull sweetpotatoes. This starch, which is noncompetitive with cornstarch, has been found suitable for use in cotton mills to displace imported potato starch. A byproduct sweetpotato starch industry is now being developed in the South. Such byproduct industries for utilization of culls and surplus are important not only for the purpose of providing farmers with a profitable market for material that would otherwise be largely wasted, but also from the standpoint of furnishing an economic stimulus to the entire community through construction of buildings, purchase of equipment, and employment of labor.

The byproduct sweetpotato starch industry, for instance, is being promoted by business men in rural trade centers for the purpose of placing in the hands of farmers cash which can later be exchanged for needed merchandise. There are many crops the economic status of which could be materially improved by organization of associated byproduct industries. Scientific and technological research is usually required in such developments for the purpose of ascertaining valuable constituents, devising methods of extraction or processing, and properly coordinating products with uses.

The farmer is primarily a producer of food and secondarily a producer of raw materials for clothing. However, the great bulk of agricultural production serves as food for man and animals. Recent studies by the Department of

Commerce of the per capita consumption of principal foodstuffs in the United States during the last 30 years show a remarkable change in habits of food consumption. There have been pronounced increases in per capita consumption of dairy products, fruits, and sugar, and a startling decrease in per capita consumption of cereals. During this 30-year period the vogue of breakfast foods has increased greatly, so that the decline in consumption of wheat flour is greater even than is indicated by the decline in per capita consumption of cereals as a group. Per capita consumption of meats, fats, and oils showed only small changes.

It seems probable that the increase in sedentary occupations and the greater popular attention which is being given to diet are factors in these changes in food habits. Calculations based on per capita consumption of each of the important food groups show that the total weight of food consumed annually by the average individual has changed very little during these 30 years. However, there has been a distinct consumption trend away from certain concentrated foods to foods such as fruits, vegetables, and milk, which are of relatively high water content. This is corroborated by the decrease in per capita food consumption calculated on a dry basis.

On the other hand, various studies of the expenditure of income of nonagricultural families for the groups "food", "clothing", "rent", "fuel", and "miscellaneous" show a progressive increase during recent years in the miscellaneous expenditures as compared with expenditures for food, although this relationship is, of course, influenced by prosperity and depression conditions. There are no data to show what portion of the miscellaneous expenditures is spent for the scores of constantly increasing manufactured articles of various kinds which are used today by every individual, family, and business enterprise. It is certain, however, that an outstanding result of scientific research and invention, which are the distinguishing characteristics of our present industrial era, is the tremendous increase in the number and variety of manufactured articles in common use.

To what extent does the farmer profit from this development by furnishing the necessary raw materials? Casein, the principal byproduct of the dairy industry, is used in the sizing of paper. Butyl alcohol, an important constituent of the quick-drying lacquers, so extensively used today, is produced by a fermentation process from corn. Cotton linters, which 20 years ago were used only for mattresses, now serve as a base for a great variety of products, such as lacquers, surgical dressings, sausage casings, rayon, etc. The proportion of cotton used for nonclothing purposes has increased steadily during recent years. Other examples could be given. Nevertheless, what has been done so far is merely a beginning in the industrial use of agricultural raw materials.

This is distinctly an industrial age, and progress in expanding markets for agricultural products lies to a great extent along industrial lines. Food requirements have definite limitations and it is very difficult to increase total per capita demand for foodstuffs. On the other hand, the consumption demand for industrial products is elastic. Creation of new products creates new wants and therefore new markets. Research thus stimulates consumption. Greater industrial utilization of farm products increases diversification which in turn contributes to market stability.

There is no manufacturing industry that has the proportion of potentially valuable, poorly utilized residue that is produced by agriculture. Such problems of utilization of byproducts have already been solved by industrial research laboratories, and their solution has frequently meant the difference between profit and loss. Agricultural industry is a laggard in the solution of this problem. This is a point upon which agricultural research should be more directly centered. The potential increase in income to farmers is vast because the full expense of producing this material has already been incurred and additional utilization represents practically clear profit.

The utilization of farm waste is equivalent to the creation of new, noncompetitive crops with cost of production already covered. Much of this waste will be used for industrial, nonfood purposes, and the diversification of use resulting therefrom will substantially increase market stability. "Farming for industry" promises to be an important development of the future.

SOIL INVESTIGATIONS

THE SOIL SURVEY

The inventory of soil resources of the United States which is supplied by the Soil Survey assumes particular importance today when the success of the Government's national policies of land use is vital to the welfare of this country.

For years the Bureau of Chemistry and Soils has been building up a classification of our agricultural lands which furnishes a scientific guide to the relative productive capacity of soils in every important agricultural region of the country. This classification includes more than 1,000 soil types in the maps and detailed reports of the Department on approximately one half the entire agricultural area of the United States. For each of these soils the surveys furnish information as to comparative fertility, crop adaptations, surface soil and subsoil texture, condition of drainage, and local adaptation to farm economy.

Immediate necessity for increasing farm income and the buying power of one third of our population, on the one hand, requires drastic decreases in the supply of major crops to meet lowered domestic and world demand. The obligation to conserve soil fertility—our basic national capital—on the other hand, requires that the millions of acres taken out of cultivation from the principal staple crops which are now overproduced, be utilized to the greatest advantage and maintained in a suitable state of fertility. Thus, the soil-survey reports which have served as practical working handbooks to assist thousands of farmers in making the best use of their soils now afford information of immediate value in the formulation and application of national land policies.

In the removal of surplus lands from cultivation the definite, scientific information afforded by the soil survey on practically every type of land encountered will be of value: (1) In making readjustments of lands to other than staple crops; (2) in correctly allocating certain soils to forestry and other soils to grazing; and (3) finally in supplying scientific data on the basic characteristics and special capabilities of each soil, so that the millions of acres which are withdrawn from cultivation or are shifted to range or forest shall become a national asset of increasing value, rather than an immeasurable capital loss.

SOIL EROSION

What has been said regarding the importance of the soil survey with respect to national land-use policies applies with equal force to the work on soil erosion. Loss of soil fertility by erosion is undermining both the capital investment and the earnings of farmers throughout the United States. Erosion surveys indicate that: (1) 35,000,000 acres of formerly cultivated land has been essentially destroyed for crop production; (2) approximately 125,000,000 acres of land now in crops has lost all or most of its topsoil; (3) that about 100,000,000 acres of land now in crops is rapidly approaching the condition of no. 2; and (4) an additional area is suffering from erosion in some degree.

Fully 75 percent of the land in the United States is subject in some degree to soil-impoverishing erosion wherever it is used for the clean-tilled crops. The annual cost of this destructive force in farm lands impoverished or ruined, highways damaged, reservoirs and irrigation ditches filled, and valley lands overflowed is estimated at not less than $400,000,000. The Bureau, at its 10 regional erosion stations, has established facts in regard to the extent and rate of soil erosion and has developed methods of erosion control which are of practical importance to a majority of the farmers of the United States and are of immediate value in the Government's present program of farm relief and crop adjustment.

The following are among the important facts which have been developed since the Bureau began its work on erosion control in 1928: Erosion varies widely with soil character, slope, and rainfall. Thick-growing vegetation is one of the most powerful agencies of erosion control. Practical measures of erosion control call for trees and thick-growing vegetation, rotations of soil-saving crops, use of tillage operations that favor absorption of water, and use of engineering structures, such as terraces and soil-saving dams.

The significance of soil character in relation to the erosion problem can be well illustrated by a single example. In 1931 red soil in the piedmont area of

North Carolina (one of the most extensive farm soils of the Southeast) lost 13 tons of soil per acre and 13 percent of the year's rainfall on a 10-percent slope, under cotton; whereas, the Shelby loam (the most extensive corn soil of northern Missouri and southeastern Iowa) lost 105 tons of soil per acre and 28 percent of the rainfall on an 8-percent slope used for corn. The rainfall was about the same, yet the less steep, highly erosive Corn Belt land lost eight times as much soil and more than twice as much of the rainfall as the piedmont land. The practical information on the comparative erosivity of the most important soil types in each major agricultural region, which has been gained from the Bureau's work at its 10 erosion stations, should prove highly valuable in the Department's program of crop reduction by indicating how the land taken out of cultivation can be protected from destructive erosion.

SOIL FERTILITY

The soil-fertility work of the Bureau deals with the soil fertility and fertilizer requirements of important soil types used in the commercial production of various crops, including cotton, corn, wheat, potatoes, sugar beets, sugarcane, sweetpotatoes, strawberries, general truck crops, citrus fruits, and nut crops.

It is desirable, in the interest of economy in production cost, that all cultivated land be used for the specific crops for which it is best suited, subject to suitable crop rotation and control of total production in relation to consumption. In this way unit cost of production may be reduced.

Even though fertilizer is bought at a favorable price, the cost is high if it is poorly adapted to the requirements of specific crops and specific soils. Knowledge of inherent soil fertility, and the relative suitability of the various soil types to specific crops, as well as knowledge of the particular fertilizer required to supplement natural soil fertility for certain crops, are important factors in reducing cost of crop production. Moreover, every acre of crop soil is subject to depreciation and decreased efficiency if proper methods of maintenance are not followed. This is a factor in conservation of invested capital, as well as in cost of production.

Owing to the complex problems presented by a number of prominent soil types and the use of new fertilizer materials of synthetic origin, especially those resulting from the fixation of atmospheric nitrogen, work on fertilizer usage in relation to soil fertility is becoming increasingly important. An important development has been the study of some of the less common elements, such as manganese, magnesium, zinc, and others which may be deficient in the soil or lacking in the fertilizer applied. It has been found, for example, that only by the use of manganese compounds has commercial growing of tomatoes become profitable on certain soils of Florida, that the use of magnesium materials in potato fertilizers overcomes a typical chlorosis of the potato vines due to a deficiency in certain soils, and that the use of zinc compounds is a means of overcoming pecan rosette.

Solution of such problems has made it possible to increase crop diversification and to take advantage of favorable climatic and market conditions in certain areas for growing crops that are in demand, but for which the soil would otherwise not be suitable, even with customary fertilizer applications. In some cases the economic well-being of entire communities has depended on special crops for which all conditions, except the presence of certain of the less common elements in soil or fertilizer, were particularly favorable.

It has been found in these soil-fertility studies that certain soil types produce crops of better quality than others; also that the use of the correct proportions of the plant food elements nitrogen, phosphorus, and potassium, supplemented with the less common elements when required, is an aid in improving the commercial quality of crops. Marketability and crop value have been materially increased by applying these principles to various crops, particularly certain fruits and vegetables.

It is evident that under present agricultural conditions an appraisal of the Nation's soil-fertility resources is important. In connection with the measures that are now being taken to control agricultural production in relation to consumption, it will be essential that the fertility of land withdrawn from cropping be maintained at a normal level. Replacement crops to be grown on land withdrawn from production of staple crops, whether cotton, wheat, or corn, should be factors in soil-fertility maintenance. Judicious fertilizer treatment also may be necessary to insure the satisfactory development of replacement crops. The

soil-fertility work of the Bureau will be of assistance in policies of agricultural adjustment in insuring the return of withdrawn acreage in as good a state of fertility as it was originally, thereby conserving soil capital.

FERTILIZER INVESTIGATIONS

During the past 2 years the expenditures of American farmers for fertilizers decreased less than for labor, feed, and farm equipment. This relatively smaller decrease in the use of fertilizers at a time of such low prices for farm products, poor markets, and depressed conditions, emphasizes the basic importance and absolute necessity of fertilizers in maintaining the productivity of the soil, the quality of farm products, and lower costs of production.

The Bureau's nitrogen fixation research program has played an important part in the establishment in this country of the direct synthetic ammonia process which is a big factor in the nitrogenous-fertilizer situation today. There are now eight plants in the United States, with an annual nitrogen capacity of some 275,000 tons. This capacity, added to that of the byproduct coke ovens, is sufficient to meet the requirements of the country, thus making it independent of foreign monopoly. Prices of nitrogenous fertilizers have dropped consistently since 1925. The average price of sulphate of ammonia from 1907 to 1914 was $58 per ton. During August 1932 it was $17 per ton. The saving in cost to farmers of the nitrogen content of fertilizers during the period 1924–32 is estimated at $125,000,000.

To date, the potash program, as conducted by Federal and other agencies, has succeeded in making the country 60 percent sufficient in its domestic potash supply. The Bureau is actively engaged in research directed to making vast deposits of insoluble potash minerals available to all sections of the country in which they occur, thereby reducing freight charges which now represent a large proportion of the farmer's potash bill.

During recent months the Bureau has developed a new material, ammoniated peat, with a high nitrogen content, which may become an important factor in fertilizer mixtures.

The policy initiated in and fostered by this Bureau for more concentrated fertilizers has resulted during the past 15 years in a 50-percent increase in plant-food content; that is, the present normal consumption of about 8,000,000 tons is equivalent to 12,000,000 tons of the average fertilizer in use before the war. This represents an estimated annual saving in bags, handling, and freight alone of about $12,000,000.

Economy in the use of a fertilizer depends on its efficiency as well as on the initial cost of the product. The cheapest fertilizer is not always the most profitable and is frequently less popular than more expensive materials. The use of efficient fertilizers not only lowers production costs but also provides a means, and in many sections the most effective means, of maintaining an adequate crop production on less acreage, with a resulting reduction in the necessary hours of labor on the farm. Well-balanced fertilizers allow a shortened working day for a given crop return by increasing the crop yield per acre, by increasing the proportion of the marketable crop, by promoting a healthy vegetative growth with consequent decrease in the loss of the crop by disease or by deterioration after harvest, and by hastening maturity with decreased loss by early frosts and autumn storms.

The results obtained with inefficient fertilizers on the other hand, may be and frequently are, the direct opposite of what follows from the use of better balanced mixtures. The success already attained in reducing costs and increasing the quality of fertilizers, which farmers regard as so vital to their livelihood, is a direct contribution to the Department's present program of increasing farm income with accompanying reduction in acreage and working hours.

In the Department's program of reducing cultivated acreage and shifting production from surplus basic commodities to other crops so as to secure a better balance of supply to demand, the maintenance of fertility of the land, and the need of suitable plant food for replacement crops are problems which will require the efficient and economical use of fertilizers. In this as well as in the technical problems involving the use of the great fertilizer resources of the Tennessee Valley, the Bureau can assist in the program of increasing farm income by land and crop adjustments.

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CHEMICAL AND TECHNOLOGICAL RESEARCH UNIT

CARBOHYDRATE INVESTIGATIONS

This work consists of chemical and technological research on the carbohydrate constituents of crops and derived farm products, the value of which is determined largely by the carbohydrate content. In general, carbohydrates constitute about 80 percent of the dry matter of plants. The purpose is to obtain better adaptation to existing market requirements and preferences and to originate new and diversified uses, both for the primary products and for the accompanying culls and wastes, thus promoting more complete utilization of these crops and increasing farm income thereby.

UTILIZATION OF SWEETPOTATO CULLS

In order to protect the value of market grades to the grower a large proportion of culls is rejected from the field-run crop of sweetpotatoes, the second largest vegetable crop in the United States. Starch of fine quality produced from sweetpotato culls by the process recently devised by the Bureau has been tested in cotton mills and found equal to German and Dutch potato starch which is used to a considerable extent in this industry. Development of a domestic sweetpotato starch industry is now taking place as a result of this work. Work on three factories is under way, and others are planned. This industry will have the advantage of low transportation costs on both raw material and products because of contiguity of large sweetpotato-producing sections to southern cotton mills. The residual byproduct pulp will be used as a needed carbohydrate constituent to balance the protein content of cottonseed meal which is now fed extensively to cattle in the South.

This new industry will provide a profitable market for sweetpotato culls, which are now inadequately utilized, thus increasing the cash income of growers. The starch is noncompetitive with domestic cornstarch and is intended to displace potato starch imported because of special properties.

Such a byproducts industry is needed for most fruits and vegetables in order to increase market stability. In abundant crop years a larger proportion of the crop could be diverted into the associated byproduct industry in order to protect the value of market grades. Establishment of this industry is also of general economic value because of construction of buildings, purchase of equipment, and employment of labor.

SUGARCANE

Because of early advent of freezing weather the sugarcane crop in the continental United States must be harvested and ground for sugar and sirup production during a short season. If harvesting is delayed, a considerable portion of the crop may undergo serious deterioration or may actually be lost. Heavy or prolonged rains are especially serious at this time, since they may render the fields impassable and so interfere with a continuous supply of cane for the plantation sugar or sirup house.

A suitable method of storing reserve supplies of harvested cane would go far toward eliminating this large average annual loss which occurs after full expense of growing (and sometimes harvesting) the crop has been incurred. In cooperation with the Bureau of Plant Industry, an investigation of basic factors influencing deterioration of stored cane was conducted for the purpose of devising a suitable method of storage.

Deterioration was lowest at high humidity and greatest at low humidity. Loss of water from the cane by evaporation is a determining factor in deterioration. It was found that deterioration can be kept at a minimum by sprinkling the stored cane at intervals in order to reduce evaporation of moisture. The more mature the cane is at the time of cutting the better it keeps under all conditions of storage.

The CO. 281 variety showed exceptional resistance to deterioration under all conditions. Other varieties, such as P.O.J. 36-M, P.O.J. 213, and P.O.J. 234, usually showed good keeping quality only when well matured. Since one of the hazards to the cane crop in the continental United States is the danger of freezing, tests were made to determine the conditions under which it is advisable to windrow, as this is the only means now employed to combat this hazard. Results so far obtained indicate that well-matured cane can withstand

a temperature of 25° to 27° F. without seriously affecting its keeping quality. If lower temperatures occur, windrowing should be employed. Deterioration which occurs during storage of sound cane consists primarily of inversion of sucrose. Organic nonsugar compounds increase gradually, but the acidity and pH of the juice change very little.

Investigation was continued on the influence of variety, soil type, and fertilizer on the yield and recoverability of sugar per acre, which are the primary factors in the value of sugarcane. These factors, and also the clarifying property of the juice, were studied with reference to suitability of sugarcane for production of sirup from standpoints of sugar content, flavor, and color. There was considerable difference in the ash content of the juice of the same variety of cane grown on different soil types. This has great influence on yield of sugar because of the effect of ash constituents on molasses formation.

Pronounced differences in iron content of the juice of cane grown on different soil types were noted. This has an important influence on the color of the juice and its suitability for sugar or sirup production. Under identical conditions the P.O.J. 36-M variety yielded sugar with less than half the color of sugar from the C.P. 807 variety. Among the fertilizers studied, ammonium sulphate was found to have an objectionable effect on quality of juice. The application of this information will have a direct influence not only on the cost of production but also on the quality and value of the products.

FARM-MADE SIRUPS

Some 450,000 small farms in the United States produce maple, sugarcane, or sorgo sirups. The farm value of these products, including maple sugar, was about $17,000,000 in 1932. The bulk of this production is marketed and is an important source of cash on small farms located over a wide area. Because of defects, such as strong flavor, dark color, "sugaring", turbidity, and sediment, much farm-made sirup is of inferior quality. Such sirup cannot be sold direct to consumers at prevailing market prices. Because of the great spread in price between high- and low-grade sirups there is hardly any other farm crop which offers such an opportunity for relative increase in value. This situation results from the fact that the raw materials, such as sugarcane and sorgo cane, are not sold as such, but are converted on the farm into sirup which is the commodity marketed.

A practical method was devised for use of malt extract in the production of sorgo sirup for the elimination of defects such as "jellying", excessive turbidity, and difficulty in concentrating the sirup to required density, which result from the gelatinization of starch contained in the juice. This solves a difficulty which has in the past been the cause of much poor-quality sorgo sirup.

Decolorizing carbon is used in sugar refining and in other industries for the control of color (and sometimes flavor), but it has not heretofore been feasible to use it for the production of sirup under farm conditions. Means were devised whereby decolorizing carbon can be used with the facilities ordinarily available at farm sirup mills, thus enabling the farmer to use this means of controlling flavor and color in competition with other commercial sirups. The technic of using carbon varies with the type of equipment, particularly the kind of evaporator used. Tests have been completed with most of the types of equipment in ordinary use and suitable directions formulated.

The placing of emphasis on light color and mild flavor in the grading of maple sirup causes a great price differential between grades with severe penalization for no. 3 grade. Yet this grade is not strong enough in flavor for certain purposes, such as use in the ice-cream industry. A method was devised for production of a mild-flavored, light-colored sugar from no. 3 grade of maple sirup together with a residual concentrate which is suitable for the ice-cream and other industries where pronounced flavor is required. It is anticipated that the removal of a material amount of no. 3 sirup from the market for use in this way will strengthen the market for no. 3 sirup used for other purposes.

This information was brought at once to the attention of farmers through county agents. Certain of these improved methods resulted last season in an increase of 25 to 50 percent in the price received by farmers for sirup in sections where the methods were applied.

The development of specialties from sugarcane was continued. The details of the invertase process for producing La Cuite of good keeping quality were

worked out. It is expected that application of the results of this investigation will lead to a wider market for La Cuite, with consequent profitable increase in production. Work on a simplified process of preventing sugaring of sugarcane and sorgo sirups by use of invertase has been completed.

UTILIZATION OF MILK SUGAR

Associated with control of production in relation to consumption there is another step to be taken in order to increase the farm value of many crops. This additional step is the effective byproduct utilization of waste. Since the expense for production of such waste has already been incurred as part of the cost of crop production, additional revenue is largely clear profit.

Casein obtained from whey is an important byproduct of the dairy industry, but the accompanying milk sugar is at present largely wasted. On a basis of 60 percent recovery approximately 165,000,000 pounds of milk sugar could be produced annually in the United States, as compared with current production of about 10,000,000 pounds annually. Wastage of milk sugar is now a liability because of sanitary restrictions relative to disposal by dumping into streams.

Investigation of uses for milk sugar has been continued in cooperation with the Bureau of Dairy Industry. Because of certain specific properties, such as limited sweetness, specific dietetic value, limited solubility, formation of very small crystals in fondantlike masses, and pronounced retention of moisture, this sugar is well adapted for special purposes in several food industries. Considerable information has been developed and industrial tests have been made with satisfactory results.

It is anticipated that increased use of milk sugar resulting from its particular suitability for certain uses would not occur at the expense of other sugars on the market, except possibly to some extent at the expense of imported cane sugar. Milk sugar can be readily produced by dairy cooperatives and in this way dairy farmers can obtain the full benefit of such a development.

INULIN

In certain plants, particularly those of the family of *Compositae*, the carbohydrate inulin plays the same part as a reserve material as does starch in the majority of plants. More profitable utilization of inulin-containing plants depends on knowledge of the properties of inulin or its derivatives in relation to possible commercial uses.

The method for producing inulin of high purity by a simple process devised by the Bureau has been applied to chicory as a possible means of increasing the value of this plant which is now a minor crop. Such an outcome would not only increase crop diversification but would also make possible the profitable growing of this crop for primarily noncompetitive purposes on acreage which is not needed for overproduced crops.

There are indications that inulin is less objectionable in the diet of persons suffering from diabetes than are other carbohydrates commonly available. Diabetes is now so prevalent that a suitable carbohydrate diet is of great importance and the use of inulin for this purpose would provide a substantial market. A large quantity of inulin was prepared and placed at the disposal of several medical specialists on diabetes who are now investigating its possible value in the diet of diabetics.

Other uses of inulin are being investigated, including production of levulose sirup as a byproduct. Because of special properties of levulose, such as high solubility (making possible the production of noncrystallizing, high-density sirups), high retention of moisture, and retardation of drying, such a sirup would be particularly suitable for certain commercial purposes.

HONEY

The recent annual production of honey in the United States is about 140,000,000 pounds, with a value of about $23,000,000. Extracted honey, as customarily marketed, has not fully met prevailing commercial standards for liquid saccharine products, and this fact has had a limiting effect on consumption. The use of honey in some industries where heating is required is restricted because of excessive caramelization. Granulation is objectionable for some uses, and excessive turbidity, foaming, and formation of scum layers has reduced marketability in some cases.

The Bureau has developed a method whereby honey may be clarified so that a sparkling, clear product can be obtained which is of very attractive appearance and largely free from the characteristics mentioned. Heretofore it has not been possible to use this method of clarification without dilution and reconcentration of the honey, but a method is now being developed whereby clarification can be effected at original density without dilution. It is anticipated that use of this method will widen the market for honey both in this country and for export, particularly to countries where a clear, sparkling, extracted honey, free from granulation, is desired.

FOOD-RESEARCH INVESTIGATIONS

The Bureau's food research deals with the improvement of existing methods and the development of new technological processes for the utilization and preservation of food crops. The subject is studied from the chemical, biochemical, and microbiological standpoints, with particular attention to the development of food and feed products and byproducts and to an understanding of the factors responsible for spoilage and deterioration in quality.

Food production is the dominant phase of agriculture. In 1930 there were in the United States more than 60 field and tree crops whose farm value was over 1 million dollars each, and whose total farm value was more than 4.5 billion dollars. Many of these products went to the fresh-food market, but census statistics show that the processing and manufacture of food and kindred products ranks first among the industries of this country, the value of manufactured food products being over 8 billion dollars annually.

This work has been developed along three major lines:

(1) The more complete utilization of food crops by the development of new food products, by the salvaging of culls, surplus, and waste, and by the further processing of byproducts, thus providing new outlets and extending markets for these crops.

(2) The prevention of spoilage and quality deterioration in both fresh and processed foods, thus preventing losses to growers by prolonging the period of consumption and preventing seasonal dumping.

(3) The development of new or improved methods of food preservation which will facilitate orderly marketing and help to counteract the evils of overproduction by making seasonal products available in satisfactory condition for year-around consumption.

None of this work deals with increasing the production of farm commodities. A more economic utilization of existing production is sought, together with a greater return to the grower. It is essentially practical in purpose and seeks new and profitable outlets for the products of the farm.

FOOD UTILIZATION

PHYTOCHEMICAL INVESTIGATIONS

Investigations were continued on the isolation, identification, and utilization of the constituents comprising the waxy coating of apples and other fruits. During growth, in storage, and on the market the waxy coatings of fruits play an important role because of the mechanical protection they afford against fungal, bacterial, and insect injury, and because of their significance in the application and removal of spray materials and their bearing on scald and other storage problems. Their importance lies in maintaining a normal, healthy condition of fresh fruit or mature vegetables sufficiently long to insure their orderly consumption as food.

Quantitative studies on the surface coating of the apple were completed. Considerable progress was made in isolating and identifying the constituents of the wax of grape, pear, and cranberry skins. The substances ursolic acid and nonacosane which have been isolated from these waxy coatings, can be obtained in quantity from skins and pomace byproducts. They have important industrial possibilities, especially as ingredients in lacquers, stencils, and similar impermeable coatings. Commercial development is being undertaken. Utilization of such waste will add to the value of these crops. Hexuronic acid was separated in crystalline form from oranges, lemons, and grapefruit. Amounts equivalent to the antiscorbutic dose of lemon juice, when fed to guinea pigs, prevented scurvy, thus strengthening the supposition that hexuronic acid and vitamin C are identical.

In studies of fruit from girdled orange trees conducted at the request of the Bureau of Plant Industry it was shown that this practice has little effect on the composition of the fruit.

ENZYMES

Darkening of dried fruit is customarily controlled by sulphuring. There is considerable consumer prejudice against this practice and it is subject to food-law regulation in most countries. Greater consumer acceptance and probably wider markets, both domestic and export, would result if a better method of preventing darkening of dried fruit were devised. With this end in view the nature of the chemical reactions involved is being investigated.

The final reaction in the darkening of apples is apparently catalyzed by peroxidase. The substances involved are hydrogen peroxide as a byproduct of direct tissue oxidation and an oxyacid which has not yet been obtained in the pure state. The latter possesses remarkable reducing properties, but does not seem to be identical with any of the substances asserted in the literature to take part in darkening of other fruits.

Methods were developed for detecting the action of peroxidase toward substances which could not formerly be tested. This permits the measurement of peroxidase in agricultural products and the definition of reaction conditions and end products.

CITRUS BYPRODUCTS

In order to promote utilization of cull and surplus citrus fruit, methods were developed for production of citrus marmalade and marmalade stock in more marketable form for sale in small retail containers or in bulk to manufacturers. These methods are adaptable to oranges and grapefruit, and also to special species of *Citrus*, such as the calamondin, which is grown extensively as an ornamental in the Rio Grande Valley.

ENVIRONMENTAL STUDIES

The composition of foods and feeds, from the standpoint of those minerals which are of proved value for nutrition, is of fundamental importance in the selection of adequate diets, both animal and human. Data available in the literature of this country are exceedingly fragmentary and are of little value in computing the intake and utilization of the mineral elements in nutritional studies. Leafy vegetables, spinach, kale, lettuce, etc., grown in different regions and in several localities in the same region, were analyzed for the ash constituents, such as calcium, magnesium, potassium, manganese, iron, aluminum, copper, phosphorus, sulphur, and chlorine.

FOOD SPOILAGE AND DETERIORATION

PHARMACOLOGICAL STUDIES

Because of the present importance of fluorine insecticides in combating insect pests, an investigation was undertaken to determine the health hazard involved in their use. The addition of 0.0025 percent of sodium fluoride to a well-balanced diet produced abnormal teeth in experimental animals (young growing rats). When the diet is poor, particularly with regard to salt balance, abnormal teeth may be produced in these animals by sodium fluoride added to the diet in concentrations as low as 0.0006 percent.

There is increasing evidence that the toxic action of fluorine is concerned with the metabolic activities of the various tissue cells and that any question relating to fluorine tolerance limit must take into consideration the adequacy of the diet. Additional toxicity studies are under way on cryolite and on sodium and barium fluosilicates.

FOOD POISONING

Freezing is a promising method of food preservation because the frozen product retains the color and flavor of the raw material more nearly than that preserved by any other means. This extension of the season for raw products, and especially vegetables, will vitally affect the market of northern growers,

whose period of production is sharply limited by climatic conditions. Because freezing does not kill all spoilage organisms, but merely inhibits their action, a fundamental study of the possibility of development of toxins in frozen products that are improperly handled at any point up to the time of preparation for the table is being made.

Previous work has shown that botulinus toxin may be produced when frozen and defrosted peas are held at room temperature for 3½ days, but not when held in the refrigerator for the same period. In continuing this study, frozen peas, some of which had been inoculated with *Clostridium botulinum* spores, were held in an ice box at 50° F. for 7 days. None of the uninoculated containers gave any evidence of toxin, but weak toxin was found in a few samples which had received a heavy inoculation.

By previous technic it was possible to isolate *Clostridium botulinum* from about 35 percent of uninoculated containers, whereas, by improved technic developed during the past year, *C. botulinum* was isolated from every uninoculated container and the cultures were typed. It was demonstrated that for prolonged periods of storage a temperature of 15° to 20° F. is not low enough to prevent spoilage of frozen peas when packed in paper containers. This temperature may be low enough, however, for hermetically sealed containers, both tin and glass. Peas packed in vacuum were in better condition in frozen storage than peas packed without vacuum.

EFFECT OF LIGHT ON FOODS

From the standpoint of market demand the farmer is inevitably concerned with maintenance of quality of his products through the channels of distribution. Deterioration in quality is immediately reflected in decreased consumption and lower prices. It has been found that packaging perishable oil-bearing foods in black or green wrappers prevents these products from becoming rancid during the usual sales period. This innovation is expected to increase the consumption of such products as corn meal, nuts, potato chips, etc. Increased consumer confidence in freedom of shelled nuts from rancidity during warm weather will benefit the market for nut crops, which have been a valuable means for increasing crop diversification during recent years.

Research on the effect of light on development of rancidity has shown definitely that light of certain wave lengths retards spoilage by rancidity. It has been found that the peroxide value of a food product is not an unfailing indication of rancidity. Black and green wrappers retard the formation of peroxides and production of rancidity, but when peroxides have eventually been developed in amounts even greater than those found in unprotected products (which will occur even if the food is wrapped so as to exclude light), the protected products will still be free from rancidity. This indicates that a second factor is involved and that its interaction with peroxides in the development of rancidity is inhibited by excluding certain light rays.

FROST DAMAGE

It has been found that variability in the electrical conductivity of the pulp of frozen oranges is an indication of frost damage. It is planned to devise a practical method of detecting frost-damaged fruit before shipment, using the conductivity as a basis. This will enable growers to salvage frozen fruit in byproducts plants, and at the same time eliminate transportation expense on this material and prevent demoralization of the fresh-fruit market.

FOOD PRESERVATION

FRUIT-JUICE INVESTIGATIONS

Last year a critical situation was brought to the attention of the Bureau by the apple growers of central Washington. Cull apples were being sold to driers and vinegar manufacturers at as low as 50 cents per ton. The apple industry was faced by ruin if some method of utilizing surplus apples could not be devised. A temporary field laboratory was established at Wenatchee, and promising juice products were obtained. These included natural and carbonated sweet cider made by clarification and flash pasteurization, and a vacuum concentrate which gave a pleasing beverage on redilution.

CITRUS-FRUIT JUICES

Work was continued on preservation of citrus-fruit juices as a means of utilizing cull and surplus fruit. Previous experiments indicated that complete removal of air and uniform heating during pasteurization are required for satisfactory heat preservation of orange juice. Concentrated and unconcentrated orange juice of satisfactory flavor and promising keeping quality was processed with apparatus that was devised. This work, conducted at the Florida field station, indicates that orange juice, properly deaerated, flash pasteurized at room temperatures between 200° and 210° F., and stored at temperatures not exceeding 50° for 6 months yields a canned product of pleasing odor and flavor.

In general, flash-pasteurized orange juice possesses a flat, but not "cooked", taste, and, to improve the flavor, orange oil from which a greater part of the limonene had been removed was added to the juice. This materially enhanced its flavor, but orange oil containing appreciable quantities of limonene was not suitable because of the "turpentinelike" taste which the juice developed in storage. The addition of orange oil to canned orange juice has been undertaken commercially with encouraging results.

Grapefruit juice properly deaerated and flash pasteurized at 200° to 210° F. yields a product superior to that obtained by present commercial methods. The addition of terpeneless grapefruit oil to packs of grapefruit juice and hearts enhanced the flavor, although this effect was not so marked as in the case of the addition of terpeneless oil to canned orange juice.

PINEAPPLE JUICE

Frozen pineapple juice stored for over a year had lost none of the flavor and aroma of the original juice.

FREEZING PRESERVATION

In response to increasing use of citrus fruits, new citrus-producing areas are expanding, notably in Arizona and Texas, and acreage in California and Florida is increasing. As new groves come into bearing, uses must be found for the increased amounts of culls, many of which are merely off-size or off-shape. Work was continued on the rapid freezing of orange slices and grapefruit hearts. It was found advisable to precool the fruit. Rapid peeling, slicing, trimming, and placing in the containers are desirable in order to shorten contact with air.

The containers should be filled as full as practicable, and should be packed under high vacuum or with an inert gas in the head space. Freezing should begin as soon as the containers are sealed. Valencia orange slices and Marsh grapefruit hearts have been kept for over a year, in both glass and tin, with satisfactory results. The results are not as satisfactory with the Washington Navel orange, which tends to become bitter after defrosting. There is a tendency for both orange and grapefruit products to lose flavor after defrosting. This is retarded by keeping them at ice-box temperature.

Fruit for commercial canning must be harvested at the "hard ripe" stage, and when picked too ripe has been almost a total loss to growers. By means of quick freezing, much of this tree-ripened fruit, which is of superior flavor and nutritive value, can be salvaged so as to yield growers a financial return. Satisfactory frozen products were produced during the past fruit season from some 20 fruits. Some of these products were pulps intended for direct consumption as frozen fruit desserts or for preparation of ice creams, sherbets, and similar products. The remainder consisted of halves or whole fruits frozen for various uses. Successful demonstrations of these products were made in New York, Chicago, San Francisco, Los Angeles, and Seattle. There is a demand for them on the part of ice-cream manufacturers, and as soon as cost and distribution problems are solved the products will be placed on the market.

VEGETABLE COLORING INVESTIGATIONS

In general, color enhances the value of farm products. The most attractively colored fruits and vegetables are the most desirable when sold for immediate consumption or for canning and preserving. Knowledge of the chemistry of coloring matters is yielding information which is important for increasing desir-

able colors and for preventing serious color deterioration in many processed food products. The tomato, in both fresh and canned form, is one of our most important vegetable crops. American tomato growers have been deprived of market outlets valued at thousands of dollars because of foreign competition, due principally to the superior color of imported tomato products. An attempt is being made to improve the color of canned tomato products.

The principal pigments in sweetpotatoes have been shown to be carotene and a small amount of xanthophyll. Owing to the presence of carotene it is logical to assume that those with the deepest color are to be considered the best source of provitamin A. Progress has been made in the isolation and crystallization of the purple pigment of purple-husk maize, one of the many color types in corn with which Prof. R. A. Emerson, one of the leaders in corn breeding, has been working. This work will facilitate the chemical interpretation of genetical factors. Breeding for superior strains of corn and other crops depends ultimately on a better understanding of the laws of heredity, including color factors.

Yellow and red pigments of apples have been isolated and tentative identifications made. Work on the isolation and identification of the coloring matter occurring in Italian and American red and American purple tomatoes, and in the Indian-red pomelo, which is related to the grapefruit of commerce, has demonstrated that the pigment in all cases is lycopin. This pigment was also found to be responsible for the pink color of Marsh and Foster grapefruits. In the Foster grapefruit the pigment is mainly lycopin, whereas in the Marsh variety carotene predominates. This explains why the Foster is a true pink and the Marsh a salmon pink.

ETHYLENE TREATMENT OF FRUITS AND VEGETABLES

In the commercial practice of treating the Japanese persimmon with ethylene, there has been the usual tendency to use fruits which are not sufficiently mature to give the best results. Experiments were conducted which showed that the sugar content of the fruit is not increased by ethylene treatment and that full flavor and color are not developed in the immature persimmon by ethylene treatment. Persimmons should be at least 65 percent colored before harvesting, when full flavor and full color can be obtained by a few days' treatment with ethylene.

Commercial experimenters have been using ethylene as a means of accelerating development of color of tomatoes picked while quite immature. The Bureau's work shows that the sugar-acid ratio is increased by the treatment owing to loss of acid and that, although there is some color stimulation, it is too slow to be of marked commercial advantage. Ethylene treatment cannot be used to advantage on tomatoes that are picked at less than the green-mature stage, which is reached when the tomato has attained full size, but before it has begun to show pink or yellow color.

FERMENTATION PRESERVATION

The feasibility of preparing food products from turnips and similar root crops by fermentation was tested as a possible means of promoting crop diversification. Twenty-five varieties of food vegetables, including some seeds imported from Europe, were grown at Arlington Experiment Farm and fermented in brine. The products were graded according to acidity, color, texture, taste, and odor. The Purple Top Strap Leaf turnip produced a sauerkraut which graded "excellent." The following turnips produced a "good" sauerkraut: Tokyo, Extra Early Purple Top Milan, Purple Top White Globe, Yellow Globe, Extra Early White Milan, and Japanese Shogain. Turnips were the only root vegetables that gave acceptable results.

A study was made of certain factors of quality in cucumbers used for pickles. Cucumbers grown at Arlington Experiment Farm were packed in brine in open jars. Analyses made during the curing process showed that the acidity rises rapidly at first, remains approximately constant for a time, and then gradually diminishes. The loss of sugars roughly parallels the rise in acidity, but the nitrogen content remains unchanged. The cucumbers were packed according to size, and it was found that the smaller or younger the cucumber the longer it resists softening of the tissues. "Soft pickles" contain much less pectin than those of normal texture.

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EGGS AND EGG PRODUCTS

It has been shown that carbon dioxide is lost rapidly from shell eggs immediately after laying, and that this loss reduces the acidity of the eggs and leads to breakdown of the egg white, a characteristic of many storage eggs. Coating the eggs with a thin oil reduces markedly the loss of carbon dioxide and saturating the oil with carbon dioxide before coating reduces this loss still further. Eggs so treated, and then held in commercial storage for 8 months, had almost the same pH value as fresh eggs and graded 25 percent higher than did similar eggs oiled on commercial egg-oiling machines. A public service patent covering this process has been granted (U.S. Patent No. 1,888,415).

Preliminary studies on the proteolytic and catalytic enzymes of eggs showed that the activity of these enzymes in the whites and yolks of unoiled eggs is greater than in eggs protected by oil treatment. This is especially true of catalytic enzymes.

INDUSTRIAL FARM-PRODUCTS RESEARCH

FARM FABRICS

The major part of the $70,000,000 worth of cotton duck sold each year for outdoor use is lacking in fire, water, and mildew resistance, fails to afford reasonable protection to goods stored under it, and soon becomes useless. The losses from the use of such inadequate canvas (including tobacco shade cloth, bagging, and that for other farm uses) are estimated at more than $15,000,000 annually.

Investigation was continued for the purpose of devising and improving treatments for canvas, tobacco shade cloth, covers, bagging, and other cotton fabrics, used out of doors on farms and elsewhere, thus making them more serviceable and more durable through increased water repellency and resistance to destructive agents such as light, fire, acids, and mildew, and decreasing losses on farm products stored and protected by such canvas. Fireproofing will increase the use of cotton for awnings which is now curtailed by city fire regulations.

The work on fireproofing indicates that the process for flame-proofing cotton fabrics with stannic oxide may be improved and cheapened by precipitating ferric iron with the tin. The iron salts increase the flame resistance of a given quantity of tin and retard the deterioration of the fabric by light. Chromium, titanium, and some other metallic salts have the same effect as iron, and thus the cost of flame-proofing can be lowered, but there is no indication that tin can be omitted. The year's work has shown, also, the need for better and cheaper glow-proofing agents. Evidence has been obtained that the very destructive effect of chlorinated organic materials on exposed fabrics can be greatly reduced by the use of colored flame-proofing oxides.

In collaboration with the Division of Soil Microbiology it was found that mildewing of leather may occur at 63 percent relative humidity, of fabrics at about 70 percent, and of paper at about 80 percent. A quicker method, using pure cultures of certain molds, has been developed for determining mildew resistance of fabrics. This method gives significant results within 2 weeks. It was found that the zinc borate mildew-proofing treatment can be applied to striped awning material without affecting the colors. Simplified procedures for preparing copper chromate and using copper chromate in mildew-proofing fabrics were devised.

HIDES AND TANNING MATERIALS

Domestic agriculture has a double interest in hides and tanning materials (1) because it supplies $300,000,000 worth of hides and skins and $20,000,000 worth of vegetable-tanning materials required each year, and (2) because those interested in rural pursuits buy about one third of the $1,500,000,000 worth of shoes, harness, belts for machinery, and similar products made and sold annually.

Agriculture is vitally interested in supplying adequate and suitable raw materials and in receiving serviceable and suitable leather goods. At present domestic agriculture supplies only half of these raw materials.

HIDES AND SKINS

Annually, $20,000,000 are lost in the wasteful handling of hides and skins. This means about $80,000,000 worth of leather goods. It is estimated that agriculture bears at least one third of these losses. Material improvement in hides and skins has been effected in combating this loss, particularly in the Southern and Eastern States. Over a large part of these sections producers are getting from one fourth to 1 cent more per pound for hides and skins, primarily because of this work. Improvement in practice has resulted in less damage in skinning, abandonment of vat curing, better built hide packs, improvements in hide-cellar construction, ventilation, and drainage, heavier salting (especially in hot weather), separate packs for skins and for hides, and the use of clean salt in curing.

Two years' research has contributed materially to our knowledge of the cause of reddening of salted hides, a frequent subject of controversy and litigation over claims for damage. This work has shown that all solar-evaporated salts examined, except those subsequently kiln dried, carried hide-reddening organisms. More significant, probably, is the finding that 64 percent of the domestic "G.A." (ground alum) salts examined also carry these organisms. Reddening organisms were not found in any of the mined or vacuum-pan evaporated salts examined.

Serious damage to cured calfskins in the form of numerous deep flesh pits, which frequently cause losses of several hundred dollars per shipment, was found to be due to curing with old, low-grade salt containing large pieces of material nearly insoluble in water. These impurities have practically no preservative action. Partial rotting of the skin immediately beneath them consequently occurs, with the formation of deep pits.

A new study has been undertaken in cooperation with the Tanners' Council of America on the recent increase in abnormally greasy cattle hides. Leather from these hides is discolored and degraded about 5 cents per pound, making a loss on a heavy hide of a dollar or more. The price received by farmers for hides is lowered because of lack of knowledge of the cause, and means for removing the grease. Studies are in progress to determine the connection, if any, between the occurrence of exceedingly greasy hides and the feeding and fattening of cattle. Experiments are also under way on processing to remove the excess grease.

TANNING MATERIALS

The United States now supplies only about half of its requirements for tanning materials for production of leather and the domestic supply of chestnut tannin is rapidly decreasing because of blight which is seriously affecting chestnut trees. A technical and economic study of waste hemlock bark of Washington and Oregon (estimated at more than 350,000 tons annually) as a new commercial source of tannin for leather with a potential annual value of $5,000,000 has been intensively pursued. Extract has been made from 80 tons of this waste bark. Data on yields and on leaching operations have been obtained. Cooperative sole-leather tanning experiments are in progress. The leather in one lot, tanned with liquors containing about 40 percent of hemlock-bark extract, is entirely satisfactory and can hardly be distinguished from the regular tannage without hemlock extract.

The studies in progress indicate that the production of tanning extracts from this bark is commercially feasible, thus adding to domestic supplies, and giving farmers and timber owners of the Northwest another source of income. Additional experiments are under way for comparison of appearance, yield, cutting value, and wearing quality of the specially tanned hemlock leather with regularly tanned leather from the same hides.

Other possible sources of tannin are being investigated as part of a program to provide a more adequate supply of domestic tanning materials. Moisture-free alder wood from Washington was found to contain only 0.4 percent of tannin; the bark contained 12.6 percent of tannin and 17 percent of nontannin substances. The bark compares favorably with eastern hemlock in tannin content. White fir bark from Oregon contained only 6 percent of tannin and 6.5 percent of nontannin substances, too little for utilization under present conditions.

In cooperation with the Bureau of Plant Industry, the tannin content of *Lespedeza sericea* is being studied in the endeavor to propagate plants of low tannin content and thus increase the palatability and digestibility of the plant as a forage crop.

FARM BYPRODUCTS

In the production of the great staple crops, the small grains, cotton, and sugarcane, there necessarily is grown an equal and usually greater tonnage of straws, stalks, and bagasse (sugarcane residue) for which on the whole there is no adequate use. Relatively small amounts are now used as roughage, bedding, or as fuel (sugarcane residue), and in maintaining the fertility of the farm. A comparatively small percentage is sold for industrial uses, such as production of paper and building boards.

A comprehensive investigation of the possibilities of using these various waste materials for a great variety of purposes is being made. Attention is being directed, for instance, to the destructive distillation of these wastes and the production of various products, including activated charcoal, carbon black for painting purposes, oils and tars for waterproofing and roofing materials, fuel gas, so-called "dry ice" and numerous other products. A study is also being made of fermentation products, including fuel gas and the recovery of cellulose, fiber, and other constituents, the thought here being that perhaps small towns, and even individual farm gas plants, may offer a useful outlet for these by-products, especially in those sections of the country where wood, coal, and natural gas are not in plentiful supply locally.

The solution of these various problems of profitable utilization of agricultural wastes involves a subject of great magnitude. The stakes involved are tremendous and a practical solution of the problem may be expected to increase farm income substantially.

DESTRUCTIVE DISTILLATION OF AGRICULTURAL BYPRODUCTS

Industrial scale distillation tests at the Bureau's experimental plant at Ames, Iowa, indicate that corncobs and pecan shells, of the materials tested, give the highest total yields of salable products. The yields compare favorably with those obtained in wood distillation. Yields of 100 pounds of acetic acid per ton from pecan shells, and 130 pounds per ton from corncobs have been obtained. Yields of methyl alcohol from these materials are lower, being about one third those obtained from beech wood. Carbon and tar yields approximate those from wood. The carbon of pecan shells is denser and better adapted for activation than is that from corncob or wood charcoal.

These activated carbons were found to be quite satisfactory in the purification of municipal water supplies, which may prove to be an important outlet for farm waste subjected to destructive distillation. Laboratory work indicates that practically all farm-waste carbons can be activated to some degree. The utility of the tar oils is being investigated, especially with respect to their insecticidal value. Distillation equipment is being studied to develop the most suitable types.

Preliminary experiments have been made to determine the fuel value of wastes, as such, and the production of briquettes for heating purposes. These experiments indicate that a briquette made of carbon and pitch has a performance and heat value comparable to soft coal of good grade. The characteristics of such briquettes can be varied at will. Briquettes for fuel are a possible local outlet for farm wastes in the prairie States and may give the farmers of these States fuel at lower cost.

FERMENTATION OF FARM BYPRODUCTS

Fermentation experiments on waste sugar-beet pulp have shown that over 40 percent of acetic acid can be produced from such pulp. Mixtures of sugar-free beet pulp with added cellulose have produced as much as 60 percent by weight of acetic acid (including small amounts of butyric acid). Fermentation experiments indicate the possible commercial production of a mixture of ethyl, isopropyl, and butyl alcohols, suitable for motor fuel, from waste corn glucose (40 percent sirup), with 15 percent yields of alcohols. The production of lactic acid from such wastes is now approaching the commercial stage.

Experiment showed that under anaerobic conditions prepared lignin is not decomposed to any appreciable extent by bacteria. No carbon dioxide or

methane is produced. Consequently no fuel value is derived from lignin in anaerobic fermentations. Addition of prepared lignin to cornstalk flour or to packing-house waste markedly reduces the fermentability of the material under anaerobic conditions. There is further evidence that this interference is not due to a soluble antiseptic substance, but may be owing to a chemical combination of lignin and protein.

A farm unit pilot plant for study of the working conditions of the production of fuel gas on the farm, from farm wastes and house sewage, is being installed in order to obtain a final solution of this problem.

NAVAL STORES

Naval stores represent an important cash crop of the South and constitute the cheapest suitable raw materials for a number of the country's largest industries. Naval-stores production is the key to longleaf pine reforestation in that it bears much of the expense of bringing the trees to timber size. Naval-stores products are worth from $30,000,000 to $50,000,000 annually, and some 300,000 people make their living from this industry. The program of work on naval stores is directed to saving for the turpentine farmer losses estimated to exceed $6,000,000 annually, on which all costs of production have been incurred; and to developing new, and extending present uses for these farm and forest products.

NAVAL STORES STATION

The naval stores station located in the Osceola National Forest, Lake City, Fla., and cooperating with the Forest Service, began the technological study of naval-stores problems September 18, 1932. For the first time, the American turpentine farmer has an adequate agency for the scientific investigation of the problems of production of naval stores and of their suitability for various uses. Naval-stores production now has an equal footing with other branches of agriculture and forestry, through the operation of an experiment station, designed, located, equipped, and manned for the solution of its problems.

The work of the station is not a program of increased production, but is one of reducing costs, of saving material on which costs have already been incurred, and of expanding uses through better and more suitable products.

The presence of small quantities of water, which may or may not be sufficient to cloud the turpentine and which finally separates when the turpentine is chilled or stands for a long time, is one of the most troublesome problems in handling and storing turpentine and causes losses of more than $100,000 annually. In order to remove this water when the turpentine is made, several types of chemical dehydrators made from turpentine barrels, which the operator can readily make, and using common salt as the drying agent, have been devised. The water is removed from the turpentine, losses are reduced, and a more stable, brighter, cleaner turpentine, more suitable for industrial purposes, is being produced, with increased returns to turpentine operators.

A fire-still plant which incorporates approved features and practices in still-building construction has been designed and erected at the naval stores station. The design is based on the experience gained by the Bureau in its field work on naval stores, and includes such additional features as are necessary in a plant designed for experimental work. This design can be readily modified to meet the needs of the operator, or his preferences for arrangement. Many operators have incorporated features of this plant in remodeling old plants. A number of plants following the general design, with more than 50 still settings worked out by the Bureau, were installed during the past spring.

The South-Eastern Underwriters Association has accepted and is using the Bureau's design, construction, type of materials, and spacing between buildings as a model set-up and gives this setting the minimum rate for fire insurance at an estimated saving of approximately $200 annually per still.

Thirteen hundred cups of 20 kinds of shapes or coatings have been hung, and comparative results are being recorded to determine the optimum shape, size, and material for turpentine cups and accessories, in order to study and prevent losses from changes in gum, and to determine the effects of these factors on properties of products. Nearly all kinds of coated cups show deterioration within 6 months.

Plans and specifications were prepared for special equipment to be used in a new process for filtering and refining crude turpentine gum. In designing this equipment, special consideration was given to the selection of suitable

alloys with a view to using only those that do not impart color to turpentine gum.

Other problems under investigation include: Dip barrels, to determine the most suitable type that will prevent losses and avoid degrading of rosins; gum cleaning, to give the producer and user a more valuable material; barrel gluing, to develop a gluing procedure that will retain turpentine in barrels indefinitely; losses from uncovered dip barrels and separators; better stilling methods to reduce cost and improve products; rosin packages, to improve them, reduce leakage and delay rotting; batting and rosin strainers, to make cleaner and higher grade rosins; recovery of rosin from dross and chips, to save $2 worth of rosin per charge.

Cooperative agents have directed the erection of 40 to 50 turpentine fire stills according to approved plans and recommendations, and additional still settings were made through their efforts. An improvement in grades of rosin amounting in some cases to several hundred dollars annually per still has been effected by using the Bureau method of distillation.

Methods of analysis and testing of turpentine, rosin, and other naval-stores products were devised as an aid in work on composition, properties, and uses, and as a basis for specifications. This work has included determination of the melting point of rosin and preparation of color standards for turpentine in collaboration with the American Society for Testing Materials.

RESIN ACIDS

Work was continued on the composition of pine gums, particularly the nonvolatile part consisting principally of resin acids. It is from this portion that rosin is formed on distilling, and from which rosin derives its properties. The purpose is to acquire basic information for controlling the character and properties of rosin, and for promoting utilization of the natural resin acids. Incidentally, this work will yield data useful in the enforcement of the Naval Stores Act. Two of these acids, alpha- and beta-pimaric acids, were prepared from longleaf-pine gum and their properties determined. There was developed an improved systematic scheme for the separation of sapinic from pimaric, and alpha- and beta-pimaric acid, which yielded these acids in a high state of purity.

Hydrogenated derivatives of these two acids were prepared. These possess much greater stability, especially in resistance to oxidation, than rosin or resin acids. The oxidizability of rosin is objectionable in its uses for making soap, paper size, ester gum, etc. Because of their greater stability, the hydrogenated resin acids should have decided advantages and if they can be economically prepared, they should lead to increased use of naval-stores products. With the object of devising practical means for preventing deterioration of turpentine in tanks and drums, during storage, final tests were made on turpentine that had been kept in experimental storage. The prevention of deterioration of turpentine will yield greater net returns to producers.

OIL, FAT, AND WAX INVESTIGATIONS

Work in this field consists of investigations on the composition and characteristics of agricultural fats and oils with reference to commercial requirements in order to make possible their more profitable production and utilization. Oil-bearing farm products now wasted or inadequately used are studied for the purpose of finding profitable market outlets.

SOYBEAN OIL

The soybean crop has been increasing steadily in recent years and is proving to be a valuable means of crop diversification, particularly in the Middle West and Cotton Belt. It is serving as a means of profitable use of considerable acreage not needed for overproduced staple crops. Utilization of the oil has not kept pace with the demand for the byproduct soybean meal and a stable market for the crop is dependent to a great extent on profitable use of the oil. There is a demand in the paint and other industries for soybean oil of high iodine absorption value to be used as an economical substitute for linseed oil, the bulk of which is now obtained from imported flaxseed.

Examination of over 70 new varieties of soybeans and their oils was made in collaboration with the Bureau of Plant Industry, for the purpose of discovering the oils best suited for technical purposes. Many new varieties from China,

Japan, and Chosen remain to be examined. It is desired to find varieties of soybeans, which yield oils of notably higher iodine absorption than do the oils now produced in this country, as such oils would be of particular interest to the paint, varnish, and linoleum industries. When such desirable varieties are discovered, provided the characteristic properties of their oils remain unchanged after cultivation in this country, it is believed that their introduction will in no small measure assist in the future maintenance of soybeans as an important cash crop, besides materially increasing its annual value.

The insoluble phosphatides of soybeans and soybean oil from North Carolina were studied for the purpose of ascertaining the cause of and means of preventing their troublesome precipitation from the oil which now reduces its marketability.

APRICOT-KERNEL OIL

The composition of apricot-kernel oil has been investigated in view of recent marked interest in the greater domestic utilization of apricot kernels from the pits which are separated at California fruit-drying plants. Between 10,000 and 11,000 tons of these pits are available annually. The kernels, which amount to about one fourth the weight of the pits, contain from 40 to 45 percent of oil. It was found that the oil contained 3.6 percent of saturated acids, consisting chiefly of palmitic and stearic acids.

The unsaturated acids amounted to 90.6 percent of the oil, and consisted of 33 percent of linoleic and 67 percent of oleic acids. The composition and keeping properties of the oil indicate that it is suitable for use as a salad and cooking oil and for roasting shelled nuts, in addition to its customary but rather limited use in the manufacture of certain cosmetics.

PROTEIN AND NUTRITION INVESTIGATIONS

PROTEINS

Chemical and biological investigations of proteins are conducted to develop information which will permit more profitable utilization of foods and feeds, and which will provide fundamental data essential for the solution of problems in human nutrition and in the feeding of farm animals. This field of investigation is of great general importance, but it has a special significance to agriculture because the farmer is vitally concerned both as a consumer and a producer.

Protein is one of the important food elements, and is the constituent that makes muscle. The protein content is a vital factor in the valuation of most agricultural food products. Foods are bought and sold to a great extent on the basis of their protein content. The protein content of wheat is an important factor in determining its price, and a graduated premium is paid for increase in protein content under certain conditions. Practically every State requires that commercial feed be labeled to show the protein content, which must not fall below a given percentage.

The value of protein concentrates used in the United States for livestock feed amounts annually to over 3 billion dollars. The protein value of a feed depends on quality as well as quantity. Not all proteins have the same food value. Some are lacking in certain nutritionally essential amino acids without which animals will not grow. Other proteins contain these same amino acids in abundance.

The effective and profitable utilization of some of our most important feedstuffs depends on a knowledge of how to combine them so that the deficient proteins can be properly supplemented by the adequate ones. Knowledge of the amino acid composition of proteins makes it possible to correct the nutritional deficiencies, for example, of several cereal grains by combining with them in the right proportion other feeds containing proteins of suitable quality. Proper supplementation based on a knowledge of the properties and composition of proteins makes possible an increase of millions of dollars in the annual feeding value of farm crops.

DIGESTIBILITY OF PROTEINS

Food proteins differ greatly in their digestibility. Some are made more digestible by heat, others are not. Certain proteins are not completely digested by the digestive fluids but leave a considerable part of some of the amino acids in the undigested fraction. These amino acids, therefore, cannot be assimilated, and the food value of the protein is correspondingly lowered. Little is known

about the relative ease or order in which the different amino acids are liberated from proteins on digestion. Knowledge of this subject is essential and fundamental for solving many practical problems in nutrition.

Experiments were conducted this year with casein to ascertain the rate of liberation of cystine, an amino acid constituent of protein essential for the growth and health of animals when the casein is digested with pepsin or hydrolyzed with acid. It was found that cystine is early liberated from casein when boiled with acids, but that it is not liberated by digestion with pepsin. Casein, however, is very quickly partially digested by pepsin, yielding peptones and albumoses. Analyses of these partial-digestion products show that they have widely different compositions and have different nutritive properties.

PROTEINS OF YEAST

The use of yeast directly for human consumption has increased tremendously during recent years. In experimental feeding tests also, yeast is generally added to the basal rations to supply vitamins. Dry yeast contains from 40 to 50 percent of protein and nitrogenous compounds. The protein and compounds of unknown character added to experimental rations introduce complicating factors which can well lead to erroneous conclusions in interpreting the results of nutritional studies. These considerations, and the meager information on the proteins of yeast, emphasize the importance of developing more knowledge on the nature of yeast proteins and their amino acid composition.

Proteins representing about 80 percent of the total nitrogen of the yeast have been isolated. These proteins are being studied and analyzed to obtain information relative to their nutritive value, and to their place in human nutrition and in the feeding of farm animals.

SUGARCANE JUICE

The presence of nitrogenous compounds in sugarcane juice presents troublesome problems in the recovery of sugar. In order to determine the effect of the proteins and other nitrogenous compounds of sugarcane juice upon the processes of sugar extraction, the changes in the distribution of ammonia, amide, amino, peptide, and nitrate nitrogen at the various stages of the sulphur-lime process of juice clarification between the original raw cane juice and the final product were determined.

VITAMINS

The tremendous development in the field of vitamins during recent years, the commercial exploitation of vitamins, methods used in the production and transportation of foods which may affect their vitamin values, methods for determining vitamins and their natural distribution, their properties and structure—all these considerations have developed the necessity of producing more information in order to meet and solve the many problems which arise in State and Federal regulatory work, and in practical problems in nutrition of importance not only in animal feeding but also in human welfare.

USE OF SALMON OIL IN FEEDING

Salmon oil can be produced which is fully equal and probably superior to cod-liver oil in the treatment of rickets in infants. This was shown in cooperative studies with the Children's Bureau of the United States Department of Labor. The results were anticipated in view of the fact that this Bureau had previously demonstrated that salmon oils are richer in vitamin D than cod-liver oil. When the value of domestically produced salmon oil in poultry feeding and as a human food is fully appreciated, it will probably replace in a large measure the cod-liver oil which is now imported.

TECHNIC OF VITAMIN ASSAY

A great deal of confusion has arisen in expressing the vitamin content of foods and feeds. With the commercial interest that has been shown in vitamins in the past few years, this confusion has become of considerable importance and serious food-regulatory problems have developed. At a conference held in London 2 years ago, international standards were adopted for four of the vitamins—A, B, C, and D—and units for expressing vitamin potency were

agreed upon. Standard vitamin preparations are issued by the National Institute for Medical Research, England, to a distributing agency in each country. The Protein and Nutrition Division serves in the distribution of the standards in this country. The preparations are issued without cost to laboratories which have legitimate use for them.

THE VITAMIN C CONTENT OF CITRUS-FRUIT JUICES

The present method of determining vitamin C by feeding experiments with animals is expensive, time-consuming, and only approximately accurate. The use of a dye, 2, 6-dichlorophenolindophenol, may prove very helpful in determining the stability of vitamin C in citrus and other fruit juices. In studies on oranges, grapefruit, lemons, and Satsuma oranges, it has been found that vitamin-C content is very closely paralleled by the reducing value of the juice as determined by this dye. With increasing quantities of fruit juices being produced and consumed, this chemical test may serve as a useful guide in eliminating unsatisfactory or undesirable processing methods.

COLOR AND FARM-WASTE INVESTIGATIONS

The color and farm-waste research of the Bureau consists essentially of investigations on the profitable utilization of farm waste and includes, incidentally, some research on colors for agricultural textile materials as follows: (1) The development of color substances which are particularly suitable for American agricultural textile materials, such as cotton, the synthetic cellulose fibers, and wool, thereby widening the market for the corresponding crops; (2) chemical and technological research on the profitable utilization of agricultural wastes; and (3) fundamental and technological research on the utilization of farm products and wastes by mold-fermentation processes.

The work of the Bureau in this field has resulted in the establishment of several industries which have directly stimulated utilization of domestic farm products and have created new market outlets. The American vat-dye industry, made possible by the method developed by the Bureau for the production of phthalic anhydride, has not only broken the foreign monopoly but has effected drastic economies in vat-dye manufacture. By the use of vat colors it is possible to obtain attractive effects more cheaply with domestic textiles such as cotton, rayon, and wool, thereby widening the market for these materials. Since vat colors give attractive shades and as a class are the fastest known to light and washing when applied to cotton, rayon, and wool, effects are obtained comparable to those secured with more expensive imported textiles, such as silk. The result has been the expansion of the use of American textile materials at the expense of other textiles of foreign origin.

The manufacture of furfural has now become an established industry as a result of work of the Bureau. In this industry more than 5,000,000 pounds of oat hulls which would otherwise be wasted are now utilized annually in the production of solvents and synthetic resins.

Work on the industrial utilization of farm products and byproducts by means of mold fermentations has resulted in the development of a number of new materials. Calcium gluconate, a valuable medicinal substance for both human and animal use, has come into industrial production as a result of discovery by the Bureau of a method by which its production cost can be reduced from $150 to 50 cents a pound. A method was devised for economical production of kojic acid, formerly a rare chemical. This substance is now being investigated by several commercial organizations with a view to its utilization. A new fatty material the chemical identity of which has not been thoroughly established and which may possess special properties of value is now being studied. All of these substances are produced by the action of molds on corn sugar. They point the way to greater diversification of the use of corn.

The work on utilization of sugarcane bagasse, which was mentioned in the last annual report, is assuming increased importance with the developments of the past few months. Cotton linters are the principal source of industrial cellulose for manufacture of nitrocellulose for films, explosives, and lacquers; of cellulose acetate for films and textiles; and of rayon. An anticipated shortage of this raw material has led during the past few years to an intensive search for other satisfactory sources of industrial cellulose. The curtailment of the cotton crop and the corresponding decrease in the supply of cotton linters will bring this situation to a climax which will require an immediate solution.

Tests made by the Bureau have shown that an excellent grade of cellulose can be produced from sugarcane bagasse, thus opening a promising market for the 500,000 tons of waste sugarcane fiber available annually in the continental United States. Industrial experiments based on these results, in which the Bureau has cooperated in an advisory capacity, have indicated that there should be no difficulty in making use of sugarcane fiber to supply needs arising from a shortage of cotton linters.

Experiments have shown the possibility of adding as much as 10 percent of organic nitrogen to the lignin sulphonic acids found in the waste liquor from the sulphite process for paper pulp. The resulting product has been shown to possess marked value as a fertilizer. The industrial utilization of this discovery would not only provide a cheap and valuable fertilizer but would go a long way toward solving the problems of stream pollution arising from the present annual output of approximately 4,500,000,000 gallons of sulphite waste liquor.

INSECTICIDE INVESTIGATIONS

Cheaper insecticides are demanded by farmers seeking lower costs of production. More effective insecticides are desired by fruit growers, truck growers, florists, and nurserymen in order to combat numerous pests which are difficult to control with known materials. Food-law restrictions against the presence of arsenic, lead, and fluorine on sprayed or dusted fruits and vegetables create an urgent demand for new insecticides that are nonpoisonous to man and domestic animals.

Research directed to improving present insecticides and finding new ones has been continued. There is indication that the growing of plants of insecticidal value may provide noncompetitive means of crop diversification which will be of distinct value to domestic agriculture. In addition, intensive efforts have been directed to the problem of the removal of arsenic-, lead-, and fluorine-containing spray residues, the presence of which on foodstuffs constitutes a grave menace to public health.

ROTENONE

Work has continued on the problem of developing from fish-poisoning plants new insecticides that are not poisonous to birds and mammals. In tests against the codling moth, rotenone has given excellent control for a few days, but at the end of a week its efficacy has disappeared because of photochemical decomposition. The use of fish tests in the study of this photochemical decomposition of rotenone and some related compounds which was begun last year was completed. These tests agreed with the entomological tests carried on simultaneously in showing that an easily made derivative of rotenone called dihydrorotenone is inherently more stable than rotenone, and that rotenone can be protected from decomposition by admixture with a light-absorbing material such as lampblack.

As rotenone becomes cheaper it will become competitive with lead arsenate, of which about 30,000,000 pounds are used annually in combating chewing insects. The use of rotenone in place of lead arsenate will eliminate the problem of the removal of lead and arsenic from fruits and vegetables, because rotenone residues are not poisonous to man. The cost of washing apples alone for the removal of poisonous residues is not less than $1,000,000 annually.

Several plant extracts and other materials were tested for toxicity. In a concentration of 200 parts per million (based on weight of original material) the extracts from Huamansana leaves and *Stillingia sylvatica* were quite toxic, and those from huaca leaves, vetiveria roots, and cubé leaves were much less so.

The final experiments relating to the carbon-tetrachloride method of determining rotenone in derris and cubé roots and other plant material were performed and the method published. The use of this method has enabled growers of cubé and derris to select varieties of high rotenone content and, by increasing the production per acre of rotenone, lower its cost.

The development of the Durham qualitative test for rotenone mentioned last year was completed and a description of it was published. It was used throughout the year in testing plants as possible sources of rotenone. Of the 49 samples tested, 32 gave no reaction. The other 17 comprised the following, the figures in parentheses indicating the percentage of rotenone found in those few samples that were analyzed: *Derris uliginosa*, *D grandifolia* (bark and wood), *Lonchocarpus vclutinus*, unknown *Lonchocarpus* sp. (8.9), *Spatholobus roxburghii*

(1.0), *Tephrosia candida* seed, *Polygonum* sp. root, *Mundulea suberosa*, Timbo root (16), Cipo (1.2), Berberra seeds, bejuco de gusano (0.4), barbasco root, Haiari root, Sopilote wood, cubé stems (0.3) and cubé leaves (too little to determine). The bejuco de gusano may be *Lonchocarpus hondurensis*.

The value of 16 percent rotenone obtained in timbo root represents the maximum so far observed in any material. The low values obtained for cubé stems and leaves confirm the assumption that only the roots of this plant are of commercial value. It has been determined that the fine roots of cubé contain a greater percentage by weight of rotenone than do the coarser ones, and that in the coarse roots the rotenone is concentrated in the bark.

A comprehensive study of the relative value of rotenone and the pyrethrins as sprays for house flies has been begun and considerable progress made, the insecticidal tests being conducted by the Bureau of Entomology. So far it has been demonstrated that rotenone, total acetone extracts of derris, and straight kerosene extracts are quite toxic to flies. As the result of this work a number of fly-spray manufacturers, including some of the largest in the country, are now incorporating rotenone or other derris extractives in their products.

CROTON

The complete toxicity-concentration curve for the toxic resin contained in the seeds of *Croton tiglium* was determined with goldfish. The fish survive only 45 minutes in a concentration of 1 part per hundred million. It is even more potent than rotenone, but unfortunately it has a considerable vesicant action which may hinder its use as an insecticide. The chemical investigation is being continued, and insecticidal tests with it are also being made.

SYNTHESIS OF ROTENONE

Partial synthesis of a number of rotenone derivatives have been accomplished. For instance, by starting with derritol, a decomposition product of rotenone, derrisic acid has been synthesized and this in turn, converted into dehydrorotenone. Rotenonone has also been synthesized from derritol. A synthesis of derritol itself would therefore complete the chain of synthesis of dehydrorotenone from the elements. Work on this is in progress.

The parent substances (compounds having the same structure without substituting side groups) of dehydrorotenone, derrisic acid, derritol, and rotenonone have been prepared. The possibility of making synthetic rotenone is considered good.

A practical method for the preparation of dihydrorotenone from rotenone (yield 90 percent) was developed. Application for a patent has been filed. Dihydrorotenone is of value because, while rivaling rotenone in insecticidal potency, it is much more resistant to decomposition by direct sunlight.

ROTENONE IN AN EASTERN WEED

Cracca virginiana, commonly called devil's shoestring, rabbitbean, and goatsrue, has been shown to possess marked insecticidal properties, and because it grows over a large part of the United States, its examination is of considerable significance.

The chemical examination of *Cracca virginiana* resulted in demonstating that the roots of this plant contain four crystalline compounds, namely, rotenone, tephrosin, dehydrorotenone, and an unidentified substance with the empirical formula $C_{22}H_{24}O_4$ and melting point 131° C. The discovery of rotenone in this weed may lead to making the United States independent of foreign sources of this valuable insecticide and at the same time provide an important crop to increase agricultural diversification by growing it on land not needed for overproduced staple crops.

NICOTINE

It has been found that, by the process of base exchange, nicotine may be introduced into bentonite clay, which then functions as an insoluble compound of nicotine capable of acting as a stomach poison with all the desirable emulsifying and spreading properties of the clay. This new product, nicotine-bentonite, may be used as a stomach poison in place of lead arsenate. It is

now being tested against the codling moth. If these tests prove successful, a greatly increased demand for nicotine will arise, and low-grade and off-grade tobaccos as the source of this nicotine may find a better market.

SYNTHETIC ORGANIC INSECTICIDES

Dithiocyanodioxane was synthesized and tested in a preliminary way against fish, to which it is somewhat toxic. Two compounds were made from the thiocyanate by reaction with aniline and with α-naphthylamine, respectively, and will be tested later. Paranitrophenylthiocyanate was also prepared and found to have considerable toxicity. Certain other organic compounds were synthesized and tested.

Previous work has shown that numerous organic compounds containing sulphur are toxic to insects, and the division is testing all easily obtained or easily made aromatic sulphur compounds. In all, 50 compounds were obtained or prepared, and the tests with mosquito larvae performed by the Bureau of Entomology showed two, namely, diphenylene sulphide and 2-phenylbenzothiazole, to be promising enough to warrant more extensive tests.

SPRAY RESIDUES

Because of the establishment of a legal tolerance for lead in foods, the solubility of lead arsenate in many different solutions of acids, alkalies, and salts has been determined to aid in selecting solutions which are capable of removing lead from apples. The determination of lead in residues required a critical consideration of analytical methods capable of estimating the quantities involved. A new procedure was developed which appears promising and which is now being given cooperative trial.

As in previous years, the apples from experimental plots around Yakima and Wenatchee, Wash., were examined for arsenic content. Information concerning arsenical residues on cabbages and tobacco was also obtained. The advantage of using nonarsenicals such as fluorine compounds in the later sprays, as evidenced by smaller arsenic residues, was again demonstrated.

Washing tests were made on various lots of fruit sprayed with various combinations of lead arsenate, mineral oil, fish oil, and cryolite. The fruit had been stored at 50° and 100° F., and washed in either a flood- or brush-type washing machine in one of three solutions, namely, hydrochloric acid, soda ash, or sodium silicate. No difference in the efficacy of the three solutions in removing arsenic could be detected with the fruit that had received cryolite and fish oil in the two final sprays. When mineral oil had been used throughout the season or in the final sprays, best removal was obtained with soda ash and poorest with hydrochloric acid. The arsenic in plain lead arsenate was removed equally well with any of the three washes. In general, fruit held in cold storage was more easily cleaned than that held in common storage. Assistance was given to growers who encountered difficulty in washing apples.

FLUORIDE RESIDUES ON FRUIT

Fluoride-containing insecticides are poisonous to man and animals; hence their use brings up the question of the residue left on food crops. The Bureau is investigating the magnitude of such residues, developing or testing methods for their determination, and devising means for their removal. During last year work on these subjects resulted in the finding of a fairly satisfactory analytical method with which the range of values for residue to be expected was determined. It was demonstrated that the ordinary washing procedures now used will probably suffice to remove fluorine if the legal tolerance is considered to be about that now enforced for arsenic (0.01 grain of As_2O_3 per pound).

FUMIGANTS

Work was done on the development of fumigants, of which those used for grain fumigation are particularly important. A survey made during the past year showed that the most commonly used commercial mixture is ethylene dichloride-carbon tetrachloride previously developed by the Bureau. The possibility of using the similar mixture of propylene dichloride and carbon tetrachloride was studied, but with unfavorable results.

Because of an abundance of fly larvae, favorable conditions with respect to supply of bulbs, additional work, in cooperation with the Bureau of Entomology, was done on the fumigation of *Merodon equestris* and *Eumerus* spp. The lethal limits in concentration and time for the naked larvae (not buried in the bulb) of both species were determined. The greater susceptibility in this case may be illustrated by the statement that, in the case of *Eumerus*, one tenth the dosage for one fourth the time gave 100 percent mortality.

A laboratory study of the effect of sulphur dioxide on the insects and mites found in a mushroom house, including the determination of minimum lethal concentrations for eggs, pupae, larvae, and adults, was completed. These tests have shown that the insects are killed by concentrations which it is possible to produce in mushroom houses. A new and more effective sulphur burner is being constructed for practical tests, and it is expected that recommendations for the guidance of growers can be decided upon before the advent of the next spawning season.

The investigation of the chemical phases of the fumigation of citrus red scale with hydrocyanic acid was continued throughout the year at the Whittier (Calif.) laboratory of the Bureau of Entomology. Numerous laboratory fumigations of scale-infested lemons with hydrocyanic acid were made under controlled conditions of temperature, humidity, and concentration to furnish the entomologists with information concerning the resistance of the scale, to obtain survivors for other experiments, and to determine the relationship between toxicity and the concentration-time integral throughout a range of concentrations and exposures.

During the past year about 220 laboratory fumigations of red scale on citrus were also made under controlled conditions of temperature, humidity, and concentration with over 100 volatile compounds, each used in conjunction with hydrocyanic acid at a concentration of 1.5 mg per liter, which has been adopted as standard for these tests.

ARSENICALS

The arsenical insecticides continue to be the most important means of combating insects; hence it is necessary that they be continuously considered even though great effort is being made to develop substitutes. Work on this project consisted of further experiments with the homologs of paris green. New greens were made with crotonic acid, erucic acid, and the acids from fish oil. The one produced by crotonic acid was well crystallized and agreed fairly well with the theoretical composition.

OIL EMULSIONS

Oil emulsions have been important insecticides for a long time, and their importance will probably increase, now that a renewed effort is being made to eliminate lead arsenate from the sprays used upon fruit and other edible products. Last year's work has shown that efficacy is not greatly dependent upon the proportion of unsulphonatable material in the oil, but is closely connected with viscosity. The oils of higher viscosity make heavier deposits on the foliage and these heavier deposits kill more insects. Confirmation of the idea that emulsions with large oil drops are more toxic than those with small ones was also obtained.

The investigation of the correlation between the properties of an oil and the insecticidal efficacy of emulsions prepared from it was continued throughout the year in cooperation with the entomologists of the Bureau of Entomology at their Gulf Laboratory in New Orleans.

FUNGICIDES

Fungous diseases of agricultural crops are very destructive. The Bureau's work in this field aims to develop new materials effective in controlling such diseases.

The principal activity in this field has been the preparation and testing, in conjunction with the Bureaus of Entomology and Plant Industry, of numerous fungicidal paints as a means of controlling the perennial canker of apple trees in the Northwest. The compounds used included beta-naphthylamine, copper stearoarsenite, copper palmitoarsenite, copper lauroarsenite, nicotine sulphate, anabasine sulphate, cuprous cyanide, paradichlorobenzene, and rotenone.

Aniline compounds with copper chloride, similar to those with copper fluoride and copper sulphate that have already been tested, have been prepared for next season's testing. No copper derivatives of acetoacetic ester, acetyl acetone, and dimethylglyoxime were prepared. They are insoluble in water and will be tested for fungicidal effect.

Building materials such as wall board are at times impregnated with arsenic solutions to protect them from insect damage. Various kinds of fungi have the power of liberating arsenic in volatile form when they grow upon a medium containing it. Analyses of various arsenicals were made, and a method was devised for absorbing and determining the evolved arsenical gases.

MISCELLANEOUS ANALYTICAL WORK

Several hundred samples were analyzed for other Bureaus, including insecticides used experimentally by the Bureau of Entomology, lead arsenate purchased on contract by the Bureau of Plant Quarantine, and bird carcasses from the Bureau of Biological Survey. In addition, many determinations of fluorine, arsenic, and lead in sprayed fruit and vegetables were made for the Bureaus of Entomology and Plant Industry.

FARM-FIRE INVESTIGATIONS

The function of this activity is to conserve invested agricultural capital, such as farm buildings, machinery, and crops by studying the causes of fires on farms and developing practical means to prevent them.

A conservative estimate places the loss from fires on farms in 1932 between $110,000,000 and $120,000,000. This property loss, which was accompanied by a life loss of about 3,500, was practically 25 percent of the fire loss of the entire United States for that year. The Bureau has conducted investigations on the causes and practical means of preventing and controlling fires on farms, which has resulted in an annual saving of millions of dollars of farm capital through reduction in fire losses and which have constituted a safeguard against interruption and possible suspension of individual farming operations.

Information on lightning control, construction of buildings, spontaneous ignition of hay, gasoline, and kerosene, heating equipment, electric wiring and appliances, fire extinguishers, water systems, and rural fire departments has been made available in printed form. This published material has been widely used by farmers, experiment stations, extension workers, insurance companies, underwriters, industry, and in fact all organizations and agencies interested in or concerned with farm-fire prevention and control.

SPONTANEOUS HEATING AND IGNITION OF HAY

Serious deterioration of certain farm crops occurs with considerable regularity after harvesting. In some cases actual destruction results, and in other cases the quality is impaired so as to reduce greatly the market value. This situation is particularly serious because deterioration occurs after the full expense of growing and harvesting the crop has been incurred.

At least one tenth of the value of the harvested hay crop, which was estimated at $632,000,000 in 1931, is lost by spontaneous heating occurring between the time when it is cut and the time when it is consumed. Investigation is being made of the effect of the moisture content, kind and volume of hay, and the effects of methods of curing, storing, and ventilation on spontaneous heating and ignition. A thorough understanding of the causes of spontaneous heating and ignition and development of means of prevention would save American farmers $20,000,000 annually from fires due to spontaneous heating and would reduce the additional loss of some $43,000,000 annually due to deterioration and spoilage resulting from abnormal temperatures and influence of oxidation.

Data compiled from continued surveys show that the leguminous hays are most subject to spontaneous heating and ignition, although fires of this nature also occur in other hays and even in straw. It also appears that barn storage is more conducive to severe self-heating of hay than storage in stacks. Spontaneous ignition occurs in chopped as well as in long hay.

Spontaneous ignition may occur in artificially cured or dehydrated hay if control of the moisture content of the finished product is poor. Cases of excessive heating followed by ignition were investigated where relatively small quantities of chopped hay came from the drier with a high moisture content,

although the remainder of the hay had been well dried. These surveys also have shown that a fire is most likely to occur in heating hay from 2 to 6 weeks after the hay has been placed in storage.

Losses from fire caused by spontaneous ignition of hay as well as losses from hay spoilage resulting from heating can be minimized by the following precautions:

(1) Hay should be sufficiently cured, consistent with the production of good quality, before being placed in mows or stacks. A range of 25 to 30 percent moisture content for long, loose alfalfa and clover hays is suggested. Care should be taken that no batch of hay goes into storage with a moisture content above 30 percent, even though the bulk of the hay falls within the range of safety.

(2) Cured hay upon which rain or dew has fallen should be cured again before being stored.

(3) Wetting of cured hay in storage, as from rain through a leaky roof, should be prevented.

DUST-EXPLOSION INVESTIGATIONS

Research on dust explosions is directly concerned with the protection of human life and property. There are 1,325,000 persons who are normally employed in 28,340 industrial establishments handling products, principally of agricultural origin, where dust explosions constitute a hazard to life and property. The annual value of their products is more than 10 billion dollars. Dust explosions in these plants, which are continually subjected to the dust-explosion hazard and which provide an outlet for farm products such as corn, wheat, oats, etc., result not only in a decrease in local markets for farm products, but also cause unemployment both of workmen in the plants and of men engaged in the handling and shipment of raw materials. There has been a continuous increase in the number of plants handling agricultural products which are subject to the hazard of dust explosions.

During the 16 years, 1917–32, inclusive, the only period for which accurate records have been kept, there have been 324 dust explosions in industrial establishments in the United States. These explosions resulted in the death of 276 persons and the injury of 613. They caused a property loss of $31,263,650, an average loss of $96,500 for each explosion.

The losses of life and property in many of the grain-handling industries as the result of dust explosions have decreased because of the work of the Bureau. The average loss per explosion over a 10-year period has decreased from $520,000 to $28,000, a net average reduction of nearly $500,000. The saving in a single year in the grain-handling industries alone is many times the amount spent during this 10-year period. It is impossible to estimate the saving in human life, but it is evident that from the reduction in dust-explosion losses a large number of workmen have been saved by the application of methods of prevention developed in this work.

One of the greatest unsolved problems in dust-explosion prevention, and one which is of particular economic importance, is that of dust collection and disposal. In many plants which handle agricultural products the dust produced in operating processes is valuable and the proper collection and handling of it constitute an important economic as well as dust-explosion prevention problem. With practically every new development for the utilization of agricultural products, it is necessary to work out new methods of obtaining protection from dust explosions in order to save life and property.

The work on dust explosions during the year included a study of the inflammability of various agricultural dusts and methods of preventing dust ignitions and resulting damage. During the year explosions occurred in the following industries: Grain handling, starch production, fertilizer manufacturing, and plants handling flour and cotton-flock dust. At the request of the Chemical Warfare Service of the War Department an explosion which occurred at Edgewood Arsenal was investigated and recommendations were made for the installation of equipment for the prevention of dust explosions.

Special attention was given to the use of dust-collecting equipment, provisions for venting dust explosions, and spray-drying equipment. Observations were made at a new type elevator employing extremely large bins for the storage of grain, in order to study the dust-explosion hazard due to this new form of grain handling. Many tests were made at the Arlington Testing Station during the year. These tests were in general a continuation of previous researches

dealing with the location and distribution of vents and the determination of venting area necessary to release explosion pressures without structural damage.

Subjects such as outside glazing and the scoring of glass were studied to determine the possibility of providing more effective venting than that provided by fixed glass. The dusts used in these tests included grain dust, cornstarch, wood flour, sugar, and powdered milk. In order to obtain a better standard for the explosibility or relative flammability of dusts, 130 dusts were tested in the laboratory at two concentrations of dust in air, namely, 100 and 500 mg per liter. Nine hundred sixty dust-explosion tests were made and three values were obtained from each test, namely, maximum pressure developed on explosion, maximum rate of pressure rise, and average rate of pressure rise.

The dust explosion hazards committee, under leadership of the Chemical Engineering Division, held its fall meeting in Chicago, and special attention was given to the revision of the Safety Code for the Prevention of Dust Explosions in Flour and Feed Mills. A new dust-explosion prevention code for woodworking industries was prepared. Nine safety codes for the prevention of dust explosions in grain-handling and associated industries have been formulated. These codes are used by insurance underwriters as the basis of rate making, and by State and municipal officials as the basis for inspection, explosion, and fire-prevention standards.

4-H CLUB WORK

Programs of activities for 4-H clubs on farm-fire prevention have been developed in cooperation with the Extension Service. The State of Oregon undertook the first organized 4-H club work in this field, the campaign being initiated by the State fire marshal in cooperation with the Extension Service of the Oregon State Agricultural College, through the medium of the State 4-H club organization. The results of this campaign have been so gratifying that it is being continued in Oregon and plans are under way for similar activity in other States. The enrollment in this farm-fire prevention movement of 4-H club members, who are usually the outstanding boys and girls in their farm community, and the carrying on of well-formulated, intensive campaigns centering on farm properties is bound to result in a greater reduction of farm-fire losses as the movement progresses and spreads.

COOPERATION WITH NATIONAL ORGANIZATIONS

The Bureau continues to have leadership of the farm-fire protection committee of the National Fire Protection Association. This committee issued a comprehensive report, Water Systems for Fire Protection on Farms, which suggests ways and means for the most efficient utilization of available water supplies in extinguishing farm fires and presents certain essential features which should be provided to give reasonably adequate fire protection when new water systems are contemplated.

The Bureau also has leadership in the committee on fire prevention and protection of the American Society of Agricultural Engineers. This committee prepared a complete report on farm-fire prevention and control.

SOIL INVESTIGATIONS UNIT

SOIL SURVEY

During the past fiscal year 27,771 square miles of agricultural lands in 29 States were mapped by the Soil Survey. This brings the total land mapped and classified to date to more than 1,500,000 square miles. The completed soil surveys of this vast area (greater than the combined areas of European Germany, France, and Great Britain) not only provide practical working maps and handbooks to assist farmers to make the best use of their soils, but also afford an inventory of national soil resources of great and immediate value in governmental policy.

Today it is being recognized as never before that land classification, founded on the results of soil surveys (which show the relative productive capacity of soils) combined with economic data, furnishes a sound basis for the development of land-use policies. This fact was emphasized during the past year when the results of previous work of the soil survey were utilized in developing a

basis for land classification in two States, the entire areas of which had been surveyed.

Using the soil survey as the basis for a comprehensive, exhaustive soil classification which has been adopted as the first step in a new land-valuation program, North Dakota has enlisted the aid of the Bureau in its effort to establish a fairer basis of taxation. In connection with the Department's present program of preventing overproduction of staple farm crops by the removal of surplus lands from cultivation, the fundamental necessity for information supplied by the Soil Survey is recognized in connection with land classification, acreage retirements, and readjustments to forestry, grazing, or other nonsurplus crops.

In the readjustment of cotton farming in the Southeastern States, as the result of the boll-weevil invasion, a knowledge of the location and distribution of different soil types enabled farmers to replace advantageously part of their cotton acreage with alfalfa. In the tobacco districts information obtained through the soil survey made it possible for the farmer to select fields where the soil is capable of producing the quality of tobacco demanded by the market. This information has been worth hundreds of thousands of dollars to the farmers of the South and East. In the West the soil survey has been of incalculable value in the extension of acreage of special crops, and the avoidance of areas where accumulation of salts and developments of alkali are a menace.

In developing reclamation projects the soil survey has proved to be of fundamental importance, since a knowledge of soil types makes it possible to avoid costly mistakes that would follow the carrying of water to lands not suited to agricultural development. The soil-survey reports and maps serve a valuable purpose in developing and interpreting the work of the agricultural experiment stations and in the farm-management plans developed by county agricultural agents. Experimental results obtained on a soil type in one section may be applied to similar soil types in other localities where sufficient knowledge of the soil is available.

The character of the soil is a most important factor in land appraisal. Land banks, insurance companies, real-estate brokers, tax assessors, and State officials are beginning to base their valuations largely on soil maps whenever they are available. Practically all departments of the Government make use of the soil-survey reports and maps, or call upon the soil-survey experts of the Bureau for service.

Tables 1 and 2 show the details of the work done during the fiscal year 1933, the areas covered, and their distribution.

TABLE 1.—*Individual areas surveyed and mapped during the fiscal year ended June 30, 1933*

State or territory	Area	Area surveyed	
		Square miles	*Acres*
Alabama	Colbert County	286	183,040
	Hale County	322	206,080
	Sumter County	271	173,440
	Winston County	[1] 225	144,000
Arizona	Upper Gila Valley area	138	88,320
California	Barstow area	263	168,320
	Concord area	102	65,280
	Lodi area	[1] 129	82,560
	Napa area	586	375,040
Colorado	Brighton area	[1] 128	81,920
Georgia	Decatur County	[1] 58	37,120
	Hall County	[1] 40	25,600
	Toombs County	68	43,520
Idaho	Bonner County	[1] 171	109,440
Indiana	Cass County	[1] 195	124,800
	LaPorte County	126	80,640
Iowa	Davis County	417	266,880
	Ida County	430	275,200
Kansas	Kingman County	[1] 108	69,120
Michigan	Cheboygan County	[1] 289	184,960
	Oceana County	[1] 289	184,960
	Saginaw County	[1] 340	217,600
	Schoolcraft County	[1] 711	455,040
Minnesota	Kanabec County	165	105,600

[1] These figures do not include portions of these areas surveyed in preceding years.

TABLE 1.—*Individual areas surveyed and mapped during the fiscal year ended June 30, 1933*—Continued

State or territory	Area	Area surveyed	
		Square miles	*Acres*
Mississippi	Marion County	[1] 323	206, 720
Montana	Lower Yellowstone area	[1] 112	71, 680
	Middle Yellowstone area	184	117, 760
Nebraska	Boyd County	61	39, 040
	Brown County	1, 235	790, 400
	Keyapaha County	102	65, 280
	Holt County	[1] 1, 512	967, 680
	Rock County	[1] 860	550, 400
	Wheeler County	68	43, 520
New Mexico	Roswell area	279	178, 560
New York	Broome County	[1] 135	86, 400
	Chemung County	407	260, 480
	Monroe County	[1] 609	389, 760
	Otsego County	70	44, 800
	Orleans County	[1] 234	149, 760
	Rensselaer County	[1] 166	106, 240
	Wyoming County	231	147, 840
North Carolina	Chatham County	[1] 257	164, 480
	Jones County	218	139, 520
	Lee County	261	167, 040
	Surry County	205	131, 200
North Dakota	McKenzie County	[1] 2, 302	1, 473, 280
Ohio	Adams County	[1] 68	43, 520
	Athens County	[1] 191	122, 240
	Logan County	186	119, 040
	Vinton County	412	263, 680
Oklahoma	Alfalfa County	[1] 510	326, 400
	Carter County	[1] 431	275, 840
	McIntosh County	[1] 414	264, 960
	Mayes County	[1] 574	367, 360
	Washita County	547	350, 080
	Woodward County	[1] 532	340, 480
Oregon	Umatilla County	[1] 410	262, 400
Pennsylvania	Armstrong County	[1] 481	307, 840
	Franklin County	[1] 618	395. 520
	Huntingdon County	93	59, 520
	Wayne County	[1] 518	331, 520
Puerto Rico	Soil Survey of	[1] 423	270, 720
Rhode Island	Washington County	196	125, 440
South Carolina	Edgefield County	[1] 184	117, 760
	Sumter County	205	131, 200
Texas	Brown County	124	79, 360
	Cass County	[1] 662	423, 680
	Hardeman County	[1] 231	147, 840
	Hunt County	409	261, 760
	Williamson County	[1] 527	337, 280
	Zavala County	820	524, 800
Virginia	Augusta County	[1] 311	199, 040
	Halifax County	112	71, 680
	Southampton County	583	373, 120
West Virginia	Pocahontas County	718	459, 520
Wyoming	Fremont County	308	197, 120
	Sheridan County	[1] 185	118, 400
	Uinta County	100	64, 000
Total		27, 771	17, 773, 440

[1] These figures do not include portions of these areas surveyed in preceding years.

TABLE 2.—*Areas surveyed and mapped in the several States during the fiscal year ended June 30, 1933, and the areas previously reported*

DETAILED

State or territory	Work during 1933	Work previously reported	Total	
	Square miles	*Square miles*	*Square miles*	*Acres*
Alabama	1, 104	56, 902	58, 006	37, 123, 840
Arizona	138	3, 945	4, 083	2, 613, 120
Arkansas	----------	15, 547	15, 547	9, 950, 080
California	1, 080	33, 731	34, 811	22, 279, 040
Colorado	128	5, 737	5, 865	3, 753, 600

TABLE 2.—*Areas surveyed and mapped in the several States during the fiscal year ended June 30, 1933, and the areas previously reported*—Continued

DETAILED

State or territory	Work during 1933	Work previously reported	Total	
	Square miles	*Square miles*	*Square miles*	*Acres*
Connecticut		1,704	1,704	1,090,560
Delaware		2,276	2,276	1,456,640
Florida		15,160	15,160	9,702,400
Georgia	166	35,696	35,862	22,951,680
Idaho	171	11,832	12,003	7,681,920
Illinois		6,770	6,770	4,332,800
Indiana	321	20,097	20,418	13,067,520
Iowa	847	47,621	48,468	31,019,520
Kansas	108	16,238	16,346	10,461,440
Kentucky		5,542	5,542	3,546,880
Louisiana		17,431	17,431	11,155,840
Maine		2,197	2,197	1,406,080
Maryland		13,959	13,959	8,933,760
Massachusetts		8,811	8,811	5,639,040
Michigan	1,629	29,319	30,948	19,806,720
Minnesota	165	10,920	11,085	7,094,400
Mississippi	323	30,417	30,740	19,673,600
Missouri		37,177	37,177	23,793,280
Montana	296	2,931	3,227	2,065,280
Nebraska	3,838	58,995	62,833	40,213,120
Nevada		652	652	417,280
New Hampshire		1,411	1,411	903,040
New Jersey		9,895	9,895	6,332,800
New Mexico	279	2,286	2,565	1,641,600
New York	1,852	30,233	32,085	20,534,400
North Carolina	941	45,371	46,312	29,639,680
North Dakota	2,302	17,388	19,690	12,601,600
Ohio	857	17,285	18,142	11,610,880
Oklahoma	3,008	17,477	20,485	13,110,400
Oregon	410	15,190	15,600	9,984,000
Pennsylvania	1,710	19,615	21,325	13,648,000
Puerto Rico	423	1,368	1,791	1,146,240
Rhode Island	196	1,085	1,281	819,840
South Carolina	389	25,550	25,939	16,600,960
South Dakota		8,286	8,286	5,303,040
Tennessee		11,198	11,198	7,166,720
Texas	2,773	59,327	62,100	39,744,000
Utah		2,419	2,419	1,548,160
Vermont		1,175	1,175	752,000
Virginia	1,006	12,231	13,237	8,471,680
Washington		10,752	10,752	6,881,280
West Virginia	718	22,779	23,497	15,038,080
Wisconsin		26,659	26,659	17,061,760
Wyoming	593	8,875	9,468	6,059,520
Total	27,771	859,462	887,233	567,829,120

RECONNAISSANCE

Alaska		31,915	31,915	20,425,600
Arkansas-Missouri		58,000	58,000	37,120,000
California		32,135	32,135	20,566,400
Kansas		39,960	39,960	25,574,400
Michigan		1,322	1,322	846,080
Minnesota	1,570	8,510	10,080	6,451,200
Montana	2,495	47,039	49,534	31,701,760
Nebraska		53,064	53,064	33,960,960
North Dakota		39,240	39,240	25,113,600
Ohio		41,420	41,420	26,508,800
Pennsylvania		41,405	41,405	26,499,200
South Dakota		41,400	41,400	26,496,000
Texas		152,855	152,855	97,827,200
Vermont		9,124	9,124	5,839,360
Washington		16,540	16,540	10,585,600
Wisconsin		14,425	14,425	9,232,000
Total	4,065	628,354	632,419	404,748,160

PEAT INVESTIGATIONS

The activities of peat investigations during the fiscal year may be divided into two main lines of work.

The first is of a routine nature—answering inquiries and assisting by advice, bulletins, and circulars a variety of correspondents and consultants whose needs are being constantly presented to the Bureau by letter, telephone, personal visits, and by samples submitted for microscopic analysis and identification. The preparation of replies to these requests constitutes a steadily increasing part of the daily work as the American peat deposits and domestic peat products become more widely known and their value as natural resources more fully appreciated.

The second line of work deals with research and cooperation with other bureaus and State agencies in an effort to locate and develop the vast domestic deposits for use in agriculture and industry.

Cooperating with the soil survey, the field work included studies of profile characteristics of peat deposits in Bellefontaine County, Ohio, and the Dismal Swamp Belt in Virginia and North Carolina. The results of this study should prove valuable in pointing out regional contrasts and the need of conserving in its natural condition a type of marginal land such as the Dismal Swamps.

In cooperation with the Bureau of Biological Survey a study was made of profile sections from the Malheur Lake Reservation, Oreg. The study vindicates the position taken by the Bureau of Biological Survey that Malheur Lake is not navigable and that draining the remnant of the shallow lake waters would be detrimental and destroy a great nesting and feeding ground for many kinds of wild fowl.

Tests conducted at Arlington Experiment Farm, Va., in cooperation with the United States Golf Association Green Section, and in nurseries and parks with the Office of Public Buildings and Public Parks, are designed to determine the extent to which mineral soils may be improved by the addition of certain grades of peat and muck. The resulting information gives timeliness to a recently published circular intended to serve the needs of peat producers in 17 States, and to point out to consumers the uses and relative values of different kinds of domestic peat products.

The results of a systematic study of the major groups of peat land, their subdivisions, the distribution of each, and their important relationships has been prepared for publication in book form.

A paper has been prepared dealing with the utilization of peat land for agriculture, industry, and national objectives. It is hoped to ascertain in the near future the distribution of peat land actually used by agriculture and serviceable for industries, the distribution of the principal crops on peat soils, and the specific commercial products manufactured in this country from peat materials.

SOIL EROSION

This Bureau at its 10 regional erosion stations has established facts in regard to the extent and rate of soil erosion and has developed methods of erosion control which are of practical importance to a majority of farmers in the United States and of immediate value to the Government's present program of farm relief.

THE PROBLEM

The Bureau's survey of the extent of soil erosion and its present rate of increase shows that unrestrained soil erosion is rapidly building a domain of worn-out land in the United States—land stripped of its rich surface soil down to poor subsoil and land gullied beyond the possibility of practical reclamation. This wastage of the Nation's most indispensable resource is not merely continuing; it is speeding up with the removal of the absorptive soil down to the less absorptive, more erosive subsoil. The extent of these damages has been revealed by recent erosion surveys of the Bureau, which indicate that land formerly in cultivation to the amount of 35,000,000 acres has been essentially destroyed for crop production and that 225,000,000 acres of land now in crops has lost all or most of its topsoil or is rapidly approaching that condition.

Farmers operating on the denuded land are subsoil farmers. Subsoil farming generally is bankrupt farming on bankrupt land. It means the cultivation of land whose productivity has been reduced by one half to one tenth that of the same land in its virgin condition. While producing a large aggregate of crops,

these farmers have but the slimmest opportunity for making a satisfactory living, whether prices are up or down.

At least three fourths of the farm land of the United States used for clean-tilled crops is subject in varying degrees to the damages of soil erosion. The annual cost of impoverishment of farm lands and damages to roads, reservoirs, irrigation ditches, and valley lands from this cause is estimated at no less than $400,000,000. This does not take into consideration the accumulating damage that cannot be measured until the last inch of topsoil has been swept out of fields.

BASIC FACTS

Now for the first time in history a very considerable amount of quantitative information pertaining to the problem has been acquired—information we should have had 50 years ago.

A number of these important fundamental facts bearing on erosion control which have been obtained since the Bureau began work on this problem are: (1) Erosion varies enormously with soil character, slope, and rainfall. (2) Thick-growing vegetation is the most powerful agency of erosion control. (Erosion of the serious kind is the abnormally speeded-up washing of land following the removal of trees and prairie grasses, and the disruption of the natural porosity of the soil by cultivation and overgrazing. Normal erosion is generally beneficial, not harmful.) (3) Practical measures for erosion control call for extensive use of (*a*) trees and thick-growing vegetation, as grass, clovers, lespedeza, etc., on the steeper slopes and the more erosive soils; (*b*) practice of those rotations which keep the land under the soil-saving crops part of the time (the clean-tilled crops being grown less frequently as the land becomes steeper); (*c*) maintenance in the soil of a good supply of absorptive vegetable matter; (*d*) use of tillage operations that favor increased absorption of rain water, such as contour cultivation, scarification of the land, subsoiling (on some lands), keeping the soil in as coarse physical condition as practicable; and (*e*) use of engineering structures, such as terraces and soil-saving dams.

VEGETATIVE CONTROL MOST EFFECTIVE

In every measurement made throughout the Nation, vegetation has proved itself a most effective agency of erosion control. The powerful effect of vegetation in minimizing erosion and increasing absorption of rainfall is illustrated by comparison of the losses from corn and alfalfa grown on similar soil and slope at the Missouri erosion farm. As against a loss of 105 tons of soil per acre and 28 percent of the year's total precipitation from corn (1931), the corresponding losses from alfalfa were only two fifths of 1 ton of soil per acre and 2 percent of the rainfall.

With respect to the soil-saving types of vegetation, there is no serious limitation to their successful use. They are effectively applicable to all soils, to all slopes, and to all regions having enough rainfall to permit plant growth, even in parts of desert areas.

Next to continuous stands of grass, lespedeza, alfalfa, forests, and other stabilizing types of vegetation, good crop rotations have proved the most effective means of erosion control, at least for numerous extensive types of farm land. At the Bethany, Mo., erosion station the average annual loss of soil under a 3-year rotation of corn, wheat, and clover has been only 13.4 tons per acre, and only 11.6 percent of the rainfall has been lost as run-off on an 8-percent slope; as against an annual average loss of 79 tons of soil per acre and 23 percent of the rainfall under continuous corn.

Strip cropping is a simple measure for controlling erosion, whereby the thick-growing crops are sown in strips along the contours of slopes between the erosion-conducive, clean-tilled crops. Water flowing down slopes is intercepted by the strips and slowed down, causing the deposition of a large proportion of the soil carried by the running water. This Bureau has worked out practical methods for use of this measure, and it is being adopted by many farmers who have seen it in operation.

OTHER MEANS FOR REDUCING EROSION

Terracing as a measure for reducing erosion, developed about 100 years ago in the Southeast, has long been used on many farms in the old Cotton Belt. Some 40 years ago the method was improved by a North Carolina farmer,

Priestly Mangum, by building broader ridges. The Mangum terrace is the type most commonly recommended today.

A properly built terrace on slopes that are not too steep and on soils that are not too erosive is the most effective mechanical means of erosion control now extensively used. On steep slopes or where improperly constructed, terraces often do more harm than good. Owing to limitations with respect to slope and the necessity for careful adjustment of the gradient to soil type, successful use of terraces calls for very discriminating procedure. It can be made (and it has been made, chiefly in the Cotton Belt) an effective implement for reducing erosion.

On the other hand, if these limitations are ignored, terracing on some soils and many slopes will result in speeded-up erosion. If used with discrimination, built correctly, and supported where necessary by good crop rotations, by strip cropping and the seeding of grass along the embankments, as many farmers are now doing on certain sandy soils of Mississippi and Georgia, terracing can be extended over a large area with much benefit in the direction of soil conservation.

The Bureau has developed a water-conserving machine that causes about 2 inches of rainfall to sink into the ground where it falls. This machine digs 10,000 holes an acre, and each hole under ordinary conditions disposes of about 5 gallons of water. It is as cheap to run as any 2-horse corn cultivator and promises to be one of the most effective mechanical means for conserving water and controlling erosion on moderate slopes especially in regions similar to the Great Plains.

SOIL-FERTILITY INVESTIGATIONS

Fertile farm land is still the foundation of national wealth. Fertility must be maintained during the period of adjustment of agricultural production to consumption. To do otherwise is to increase production costs and dissipate invested capital.

In order to evaluate the fertility of prominent soil types on which our major crops are produced and to determine their plant-food requirements, the Bureau is conducting a program of soil-fertility work in cooperation with State agricultural experiment stations. Field headquarters are located in regions where the crops are grown commercially in order to maintain close contact with growers and shippers and to obtain results at first hand. Soil fertility and fertilizer problems relating to important crops, including cotton, potatoes, sugarcane, sugar beets, and truck, citrus, and nut crops, have been solved to an extent which has materially aided farmers to obtain a more economical return from the soil. It is imperative today, with new problems facing the farmers of the United States, that soil fertility be maintained and that the application of methods to this end harmonize with methods of adjusting supply to demand.

Research on fertilizer materials and complete fertilizer mixtures has resulted in knowledge which goes far beyond the stage of 20 years ago. More and more evidence is forthcoming, as the result of soil-fertility studies, that the old assumption that nitrogen, phosphoric acid, and potash are practically the sole dependence of crops for plant food is no longer valid. In the light of modern fertilizer practice, elements such as manganese, magnesium, zinc, copper, and the like are proving to be important additions to the roster of plant-food elements, as is shown by some of the statements which follow.

MAGNESIUM DEFICIENCY IN SOILS

Cooperative field studies are showing that available magnesium, a plant-food element concerned with the development of chlorophyll in plants, may be deficient in different potato soil types to an extent seriously affecting economic production of the crop. Symptoms of magnesium deficiency shown by the potato plant are: Yellowing of the lower leaves, the yellowing progressing from the margin toward the midrib; stunted growth; brittle leaves; and lowered yield. In advanced stages of the disturbance the leaves often develop dead tissue areas. An analysis of potato foliage from affected areas and from those producing normal plants showed that the normal foliage contained from two to three times as much magnesium as the foliage from affected plants.

Magnesium deficiency occurs most generally in soils relatively low in organic matter and highly acid in reaction. The inclusion of different magnesium compounds, such as magnesium sulphate, manure salts, or dolomitic limestone, in fertilizer mixtures has been found to raise the yield level to a point insuring

more economical production. In Virginia, for example, the addition of magnesium sulphate to a regular potato fertilizer increased the acre yield nearly 50 bushels. In Maine, equally good responses have been obtained.

Fertilizer manufacturers are adding magnesium compounds to their fertilizer mixtures to overcome magnesium deficiency, largely as a result of the cooperative work conducted under this project. The field results indicate that the addition of magnesium compounds to potato fertilizer in amounts equivalent to 20 to 25 pounds of magnesium oxide to the ton greatly improves the growth of potato plants and materially increases the yield.

ZINC DEFICIENCY IN SOILS A CAUSE OF PECAN ROSETTE

Through laboratory and field work it has been found that zinc deficiency in soils is an important factor causing rosette, a nutritional disease of pecans, which is responsible for great loss to growers. The addition of small quantities of zinc sulphate to the soil, or applied to the trees as a spray, cures and controls the disease. Commercial growers are using zinc, which is proving of considerable value.

Green-manuring crops for pecan orchards have proved of great value. Aside from making the soil more retentive of moisture in times of drought, a winter green-manure crop turned under in early spring, in decomposing, maintains a satisfactory level of nitrate nitrogen during the summer, thereby eliminating the need of using the higher priced slowly available nitrogenous fertilizers, such as tankage, fish scrap, dried blood, and cottonseed meal.

LESS COMMON ELEMENTS IN FERTILIZERS

Field comparisons of single-, double-, and treble-strength fertilizer mixtures on a number of important soil types in leading potato-producing sections continue to show the economic importance of concentrated fertilizers. Farmers and their organizations and fertilizer manufacturers are showing great interest in the work and are utilizing the results to advantage.

A comparative greenhouse study of continuous soil treatment with fertilizer mixtures containing impurities against pure-salt fertilizer mixtures has furnished indications that the continuous elimination of minor elements exerts a depressing influence on crop growth. This was particularly prominent on radish foliage which displayed distinct symptoms of magnesium deficiency. Field studies made on Caribou loam soil in Aroostook County, Maine with other less common elements of plant food, such as copper, manganese, nickel, and zinc are showing that a soil of such high fertility as Caribou loam does not respond as markedly to these elements as lighter, more readily leached soils in other regions. In fact, the heavier rates of application of these elements on this soil type depressed yields. Field studies on Caribou loam employing lighter rates of application are being conducted to determine whether stimulating effects will result from any of the less common elements.

FERTILIZER TREATMENTS IMPROVE QUALITY

In experimental work in Florida, manganese sulphate, when used in conjunction with fertilizers has proved effective in maintaining the vigor of citrus trees, producing larger yields, better quality, and better color of the fruit. Oranges and tangerines grown where small quantities of manganese have been applied periodically for several years exhibit a desirable, deeper yellow color after being submitted to packing-house coloring processes.

STRAWBERRY SOIL AND FERTILIZER STUDIES

Three years' results with strawberries on the sandy loam soils of the principal strawberry-growing sections of North Carolina, which are typical of strawberry soils of the middle Atlantic Coastal Plains, consistently show that fertilizers containing 6 percent of nitrogen, 8 percent of phosphoric acid, and 6 percent of potash give best results when viability of strawberry plants, yield of strawberries, and quality of fruit are considered. Applications of quickly available nitrogen carriers in early spring proved detrimental to the quality of strawberries as shown in shipping tests, and this practice should be discouraged for commercial plantings, although yields may be increased thereby.

The water-soluble salts in soils, as influenced by added fertilizers, and also the reaction of soils, as influenced by added physiologically acid and physiologically alkaline fertilizers, have proved to be important factors in the viability of strawberry plants. These are important factors in strawberry growing in the coastal plains of the Atlantic seaboard, for great loss is experienced by growers from poor viability of plants and many plantings die in the first and second years during unfavorable weather.

COTTON FERTILIZER STUDIES

Soil fertility and fertilizer investigations with cotton soils embrace field experimental work in Virginia, North Carolina, South Carolina, Georgia, and Texas, on the most extensive soil types devoted to cotton production. Data based on the experimental work of the Bureau point the way for more economical use of fertilizers and lower production cost. In the southeastern Cotton Belt best results have been obtained with fertilizers containing nitrogen approximately 80 percent from inorganic sources and 20 percent from organic sources.

Experiments in cooperation with the Georgia Experiment Station are in progress in Georgia in the principal soil types used for cotton production Some of the upper coastal-plain soils required principally nitrogen and some required both nitrogen and potash to control cotton rust. The Decatur soils of the western part of the State required principally phosphoric acid and a relatively small proportion of nitrogen and potash for best results. On cotton root-rot infested soils of the black-land belt of Texas, readily available nitrogen and phosphate stimulate the growth and fruiting of cotton and tend to check the development of cotton root rot.

Considerable attention is being given to placement of fertilizer in relation to the seed, use of large quantities of fertilizers and chemicals applied in advance of planting, and to deep tillage and subsoiling. Subsoiling in the late summer and fall, in conjunction with the use of quickly available nitrogen and phosphate, is a promising means of profitable growth of cotton in cotton root-rot infested lands. Proper placement of fertilizers is essential for their efficient use in the production of cotton and it has been demonstrated that the preferred placement is to each side of the row, below level of the seed.

FERTILIZER STUDIES WITH SUGAR BEETS

Fertilizer experiments with sugar beets indicate that, due in part to the variation in previous treatment or cropping, no two soils so far tested necessarily respond alike to the same fertilizers; but the response to fertilizers is greater on some types of soil than on others. With proper fertilization certain alkali fields in the irrigated sections of the West can now be made to produce successful crops of sugar beets that otherwise would be a failure. An experiment near Minatare, Nebr., produced on the unfertilized plots an average of less than 3 tons, whereas the fertilized plots produced an average of 12 to 14 tons of sugar beets per acre. In the past this type of land has been avoided for planting to sugar beets, owing to low yields, but with the use of fertilizer—principally phosphate—profitable returns are being obtained from its use, through reduction of cost per ton of beets.

Experiments conducted on other soil types in various localities have shown that fertilizers applied to certain soil types show profitable returns, whereas others produce insignificant increases. Three different fertilizer mixtures—phosphate alone, phosphate and potash, phosphate and nitrogen—produced 15.2, 16.8, and 16.8 tons of beets an acre, respectively. The average of the unfertilized plots was 4.93 tons of beets per acre. The same three fertilizer mixtures applied to Waukesha silt loam produced 10.2, 10.1, and 9.7 tons of beets an acre, respectively, whereas the average of the unfertilized plots of the same field was 9.6 tons of beets. It is the purpose of the soil-fertility studies on sugar beets to determine the soil conditions and soil types on which commercial fertilizer can be used with profit.

SUGARCANE SOIL AND FERTILIZER STUDIES

A complete analysis of four of the more important soil types of the sugarcane belt of Louisiana, including Yazoo very fine sandy loam, Sharkey silty clay, Lintonia silt loam, and Yahola very fine sandy loam, was completed during the

past year. The analysis shows that these soils are adequately supplied with most of the inorganic plant-food materials, but organic matter is rather low in all, except the Sharkey soils.

Two years' results of studies on the composition of sugarcane juice, as influenced by soil types and fertilizer treatment, were completed at the Houma laboratories. The data indicate that the application of nitrogen as fertilizer increases the nitrogen content of the juice to an appreciable degree and also decreases the ash content of the juice, compared with juice from unfertilized cane. These effects seem to be directly proportional to the amount of nitrogen applied as fertilizer. Applications of potash or phosphate fertilizer tend to increase the ash content of the juice over that of unfertilized cane. Application of phosphate apparently does not increase the phosphorus content of the juice.

The highest yield (35.91 tons per acre) of plant cane on Sharkey silty clay was obtained from ammonium sulphate alone. The yield from the unfertilized plots was only 23.28 tons. Phosphate alone produced less than 2 tons over the check, and potash alone approximately 2 tons less than the check. The all-nitrogen and the fertilizer mixtures containing 12 and 16 percent of nitrogen produced an average of approximately 2,000 pounds of sugar an acre more than the unfertilized checks.

FERTILIZER-PLACEMENT STUDIES ON POTATO SOILS

The importance of commercial fertilizer in the production of the potato crop necessitates careful usage. In normal times potato growers use 30 to 40 million dollars worth of commercial fertilizer. Faulty application may easily result in injury to the seed piece and cause poor germination, weak plants, and reduced yield. Field work comparing different methods of fertilizer application or placement on prominent soil types in Maine, New Jersey, Ohio, Michigan, and Virginia has afforded results indicating that placement of fertilizer in narrow bands, about 2 inches away from and either on a level with the seed piece or 1 to 2 inches below, is generally the preferred method of applying fertilizer to potatoes.

VEGETATIVE TESTS WITH AMMONIATED PEAT

The evaluation of ammoniated peat for fertilizer usage and the effectiveness of ammoniated sulphite lignin as a nitrogenous fertilizer material were investigated. More work will be required before final conclusions as to the value of these ammoniated products can be made.

CHEMISTRY OF SOIL ORGANIC MATTER

Work on humus compounds has been confined largely to a continuation of the investigation of uronic acid complexes or uroneides and sterols in soils. Examination of profile samples of virgin soils has given values for the ratio of uronic acid carbon to total carbon which are quite variable, but which are in keeping with those already obtained.

The presence of sterol compounds in soils has been recognized for several years, and is known to be due in part at least to the activity of soil-forming fungi. The biochemical interest in sterols centers around the fact that one sterol (ergosterol) is identical with or closely related to vitamin D. Examination of selected soil samples has shown that sterol compounds are found in all horizons, that several may be present in the same soil, and that the character of the sterols may be quite different in different horizons of the same soil.

CYANURIC ACID

Since the discovery by the Bureau of cyanuric acid in soils, interest in the function of this nitrogenous soil compound has continued, and soils selected for this purpose have been examined for the occurrence of this constituent. It has been shown that in some soils high in nitrogen content, such as peats, this nitrogenous constituent may be absent or present only in very small quantities, but in many soils of the East, containing little nitrogen (0.05 percent or less), cyanuric acid equivalent to half the nitrogen may be obtained.

DEVELOPMENT OF ANALYTICAL METHODS

A large amount of miscellaneous work of a service nature for farmers and other individuals has been done. In connection with the field problems of the Bureau, as well as in investigations conducted by other bureaus, considerable research in developing suitable methods has been necessary. This has been particularly true for iodine, arsenic, and copper determinations, for which satisfactory methods of analysis have been developed.

SOIL AND FERTILIZER INFORMATION SERVICE

In response to the thousands of requests for information the Bureau has sent out information on soil fertility, fertilizers, and manures, composting, home mixing, and soil amendments to inquirers from all sections of the country, and the publications on home mixing and composting have continued to be in active demand. A large number of samples of soils and fertilizers were examined and advice as to their use and value furnished. When necessary, farm and garden problems were studied locally in the field. Due to the economic depression, a great number of unemployed city families have gone to the farm for subsistence and the Bureau has given many of them advice and assistance, both by letter and by personal contacts.

SOIL MICROBIOLOGICAL INVESTIGATIONS

IMPROVED INOCULANTS

Farmers growing legumes have received increasing protection from the Bureau's annual inspection of hundreds of legume and soil inoculants. This inspection is so thorough that the bacteriological examination, greenhouse inoculation of seedlings, and field tests require a period nearly equaling the cropping period on the farm and the results of inspection have not been available in time to remove a worthless product during its first year on the market. Owing to this situation, farmers in certain sections of the South recently suffered losses from poor inoculants for Austrian winter peas. To prevent such losses the inspection is being broadened to include equipment, methods, and personnel of production in order that faulty procedures may be detected and eliminated before the product reaches the market.

The more recent experiments with inoculated legumes have shown that nodule production alone is not a guaranty of the most beneficial activity. After developing and collecting the most effective strains of inoculants, the Bureau is furnishing them to institutions and commercial organizations which supply the farmer.

FOREST SOIL MICROBIOLOGICAL POPULATION

The problems of reforestation and of maintenance of existing forests, which are now increasingly important, involve the necessity of close study of the biological activities which are significant in the return of the litter and waste of these areas to the soil as plant food. The balance between fungi, bacteria, protozoa, worms, insects, etc., presents a complicated series of problems which vary with the climate and soil type and the composition of the forest itself.

Studies and observations of these conditions show a predominance of fungous flora on the forest floor where the soil is very acid, whereas bacteria and earthworms are most in evidence where less acid conditions prevail. Critical and intensive studies are needed to correlate particular forest soil microbiological populations with particular production problems.

ARSENIC POISONING OF SOILS AND DWELLINGS

Arsenical substances totaling 70,000,000 pounds are reported to be used each year in the United States for insecticidal and fungicidal purposes. The larger part of this arsenic eventually reaches the soil as spray residue in one form or another. Arsenic injury to crops is now definitely proved in some of these areas. A survey of the so-called "arsenic fungi", which render compounds of arsenic volatile, has shown that our soils contain abundant molds which are capable of setting arsenic free from the various combinations carried to or formed in the soil. Arsenic has been assumed to be fixed in insoluble or very slightly soluble substances. Molds, however, are known to decompose these

substances so that the arsenic reappears in soluble and volatile forms; hence, it may be toxic, may leach out, or may escape to the air. Under such conditions soil should free itself eventually from arsenic of concentrations toxic to crops.

In the same survey organisms common in the rotting of wood have been found to be tolerant of the concentrations of arsenic used to prevent insect infestation, and hence are capable of producing arsenical odors from wood, fiber board, or other substances so treated. Instead of being few and rare, common and abundantly distributed organisms have been found to act as arsenic fungi. The use of arsenic in situations where such activity can take place and where the poisonous gases may be confined in living quarters, carries with it a menace of poisoning which is not to be ignored.

MICROBIOLOGICAL METHODS FOR TESTING SOIL DEFICIENCIES

Several microbiological methods of testing soil for fertilizer deficiencies have been proposed in recent years. Some of them have been used and good results have been claimed in limited areas, whereas disappointment only developed elsewhere. Two of these methods have been studied during the past year.

On account of the wide-spread interest in the test and the many requests for information, the Winogradsky Azotobacter plaque method for determining phosphorus deficiency of soils has been applied to various eastern soils. The results indicate that this method has no general or practical value when used on eastern soils, although in a few cases it may be modified so that it will indicate deficiencies to some extent.

Another method consists in testing soil by inoculating samples, treated in routine manner, with *Aspergillus niger*. Results obtained by the Bureau indicate that, if the variable factor can be restricted to only one element—that is, nitrogen, phosphorus, or potassium—soil samples can be so treated as to give increasing amounts of mycelium with increasing additions of the element in question up to a maximum beyond which no further increase occurs. From these results a production curve for each soil type can be established for each of the three elements, nitrogen, phosphorus, and potassium. New samples of the same soil can then be tested in routine fashion and the needs calculated from the points where they fall upon the curve.

These results indicate that the method is feasible where the resources of a well-equipped laboratory are available. Tests with three different soil types have shown that the method must be calibrated for any one or probably for a group of soil types similar in such factors as origin, reaction, fertility, and texture. Laboratory results have correlated closely with those from plots of one type of soil under rigorous control in the greenhouse.

CELLULOSE DECOMPOSITION

Studies of cellulose decomposition have taken two forms. (1) Certain bacteria known as Cytophaga, which are of world-wide distribution and which are reported to be active in cellulose decomposition, have been investigated. Laboratory studies, however, indicate that this activity is limited by temperatures and moisture requirements which greatly reduce their probable significance in the field. Surveys of their occurrence are in progress.

(2) Another type of cellulose destroyer has been found in the genus *Chaetomium*, a group of molds cosmopolitan in occurrence and familiar in the laboratory, but whose vegetative mycelia have not previously been studied. When tested on fiber materials in the laboratory, these organisms proved to be very active destroyers of cellulose and related substances. They were tolerant of quite varied temperatures and were active within a wide range of moisture conditions. These characteristics have resulted in the use of *Chaetomium* in testing the mildew resistance of cotton textiles used as canvas, tobacco shade cloth, bagging, and for other farm purposes.

SOIL CHEMISTRY AND PHYSICS

During the past year the major interest of the Division of Soil Chemistry and Physics has been centered upon the study of soil colloids. Previous study has shown that the colloid, which makes up the fine material in the soil, has a profound effect upon both the chemical and physical behavior of the soil. The particular soil properties depend upon both the nature and the quantity of colloid present. A thorough knowledge of the amount and quality of the col-

loids in a given soil should enable one not only to understand and predict the probable effect of additions of fertilizers and manures but also to trace the origin and subsequent development of the soils of the various soil groups. The colloids exert a dominant influence upon the capacity of the soil for retention and distribution of soil moisture. Much additional information has been gained by recent investigations along these lines.

It has been made increasingly evident that blanket specifications for agriculture are not practicable over other than limited areas, and that agricultural practice must be based upon soil classification. The colloid studies have shown that plant-food storage is a function of the colloid content. It has been found that the sandy soils, especially where rainfall is heavy, are not only poor in colloid but that present is likely to have low plant-food capacity and that in wet and hot climates the colloid is in general of a type which cannot store up plant food. It is therefore hopeless to attempt to build up such soils to a state of so-called permanent fertility. Even large increase of organic matter is impractical since the climatic conditions which produce colloids of low fertility also tend to destroy organic matter. Such soils must be handled differently from those containing other types of colloid. They must be supplied with plant-food material in small quantities at frequent intervals.

In the case of soils developed under cooler climate and higher rainfall the colloid, when depleted, may be built up in plant food, and added fertilizers are not necessarily exhausted in a single season. Organic colloids may be accumulated by the use of green and other manures. In the case of soils developed under low rainfall but yet sufficient for crops, the plant-food supplies are likely to be abundant and no need for fertilizers is felt except under special circumstances and for special purposes. It must not be inferred that such soils are immune to injury from improper handling. They may be greatly damaged by erosion, by wind or water, and in many cases this has occurred even to the complete removal of the true soil. Soils have been permanently impoverished by the leaching of their plant food by smelter fumes, or other acid additions, to an extent which renders their reclamation economically impossible. In irrigated areas improper soil management may produce injury by bringing up from lower levels soluble materials of such character and quantity that their removal at reasonable cost is impossible.

Recent and very difficult investigations of the organic matter of the soil have revealed a number of new facts about the organic colloid. Thus it was found that the organic colloid, like the inorganic, is amphoteric; that is, it may function at the same time as an acid and as a base. Furthermore, the organic matter of the soil varies in composition in different areas and the nitrogen content is highly variable in different areas and at different depths, particularly with respect to the carbon-nitrogen ratio.

Studies of the behavior of the soil with water have developed two new relations: The maximum volume of soil in equilibrium with water is variable in soils of divergent types, and distribution of water within the soil also is varied by the character as well as by the quantity of colloid.

There have been developed a number of new or improved methods of soil examination. Among these is one for the estimation of selenium in soils and another for vanadium. Still another is an improved process of determining the available bases in a soil and of the total base-holding capacity.

FERTILIZER INVESTIGATIONS UNIT

The activities in the field of fertilizer investigations are of practical importance to the farmer through the development of methods for the most economical production and use of the various fertilizer ingredients. This involves studies of the chemistry and economics of the manufacture of various compounds of nitrogen, phosphorus, and potash from the many sources, followed by the determination of the properties of these and how they may best be utilized in the final mixed product. Since the fertilizer industry is well established, many of the activities involve improvements and assist in meeting new conditions that constantly arise. A few figures will serve to emphasize the present importance of fertilizers to the farmer and the changes that are taking place.

The consumption of commercial fertilizers in the United States during 1932 amounted to 4,361,795 tons, as compared with 6,293,041 tons in 1931, and an average of 7,689,422 tons for the preceding 5 years. The fertilizers used in 1932 contained 215,730 tons of nitrogen, 431,250 tons of phosphoric acid (P_2O_5), and

164,945 tons of potash (K_2O). The average analysis formula of the fertilizers consumed during the year is therefore 5-10-4, showing an increased use of nitrogen relative to both phosphoric acid and potash.

Although the consumption of fertilizers is largely centered in the southern and eastern sections of the country, the expenditures for this item by the farmers of the country as a whole for crop production is only exceeded by that for labor, feed, and farm equipment. During the past 2 years the expenditures for fertilizers decreased less than for any of the other three items mentioned. This relatively smaller decrease in the use of fertilizers at a time of such low prices for farm products, poor markets, and depressed conditions in general indicates the basic importance and absolute necessity of fertilizers in maintaining the productivity of the soil, the quality of farm products, and lower costs of production.

Previous to the World War the United States possessed a plentiful supply of only one of the fertilizer ingredients, phosphoric acid. A large part of the nitrogen was imported and practically all of the potash. Since that time researches on our natural resources have resulted in making the country independent in regard to the nitrogen supply and potentially so in regard to potash.

The mixed fertilizers now on the market differ radically in composition from those in use before the war. The use of organic nitrogen, for example, has decreased from 57 percent of the total in 1913 to 19 percent at the present time. Ammonia nitrogen increased on the other hand during the same period from 24 percent to over 60 percent. Nitrate nitrogen has decreased from 20 percent to 11 percent, whereas the use of many synthetic materials, such as urea, has greatly increased. These and other changes in the sources of materials used have changed the chemical, physical, and physiological properties of fertilizer mixtures with the result that the investigation of these properties is more necessary than ever before. The success attained in further reducing the cost and increasing the efficiency of fertilizers depends in large measure on the solution of the problems that thus arise in connection with their changing composition.

NITROGEN

CATALYSTS IN NITROGEN FIXATION

The early activities of this project were largely responsible for the introduction of a suitable catalyst for use in the direct synthetic ammonia process under manufacturing conditions. The methods then used were of necessity empirical, due to limitations of time; the present work is more concerned with the nature of catalytic action.

One important conclusion to be drawn from this year's work is that the rate at which ammonia is formed on a catalyst depends on the rate at which nitrogen is adsorbed by or reacts with the surface atoms of the iron catalyst. Incidental to measurements of equilibrium over catalysts (data used in connection with the preparation and purification process in the synthesis of ammonia), the discovery was made that practically all previous similar measurements were in error. This discovery will permit a more accurate calculation of the maximum efficiency of the various processes involved.

PHYSICAL CONSTANTS OF GASES AND FERTILIZER SALTS

Since the synthesis of ammonia was the first high-pressure process utilized commercially on a large scale, none or only inadequate physical data were available. After measuring the compressibilities of hydrogen, nitrogen, and mixtures of hydrogen and nitrogen over a wide range of pressure and temperature, it was found necessary to include carbon monoxide, methane, and helium. The compressibility of helium is of particular interest in the study of the mechanism of synthetic ammonia catalysts and incidentally of others too. The knowledge of the solubility of the various gases in water is of importance in the gas-purification process which precedes the catalytic conversion to ammonia and byproducts.

The solubility of hydrogen in water has been determined over a temperature range from 0°–100° C. and up to 1,000 atmospheres, and similar measurements on nitrogen have been made from 25° to 100°. Mathematical treatment has given added importance to the above-mentioned compressibility data by developing precise methods for calculating quantities such as high-pressure specific heats, entropies, coefficients of expansion, and similar data not only for the

measured range, but also for higher temperatures and pressures. These calculations have been in great demand.

The photoelectric, spectroscopic, thermionic, and X-ray investigations have added greatly to our present understanding of the synthetic ammonia catalyst and of the mechanism of reactions involving nitrogen fixation. The application of X-rays to biology has presented many interesting aspects and is being actively prosecuted in cooperation with the Bureau of Plant Industry. X-ray analyses are also of great aid in analyzing complex fertilizer salts, and checking and following various processes in fertilizer technology.

UREA SYNTHESIS

Since the production of ammonia by synthetic processes has attained large proportions not only in this country but throughout the world, the use as fertilizer materials of conversion products from this source has increased rapidly. Some of these products, as well as the ammonium sulphate from by product sources, give a decided acid reaction in the soil. The desire for a conversion product less acid in its reaction has been met in part by the development of a process by the Bureau for the synthesis of urea. The process employs only the two products from the direct synthetic ammonia process, namely, ammonia and carbon dioxide. By heating a mixture of these two compounds in an autoclave at 150° C., a partial conversion to urea takes place. This process has been put into commercial operation at one plant in this country and the product is being employed in the preparation of mixed fertilizers. As a result of this synthetic production of urea, it is now obtainable for fertilizer purposes for about 4 cents a pound, whereas previously it was far too expensive a chemical to be considered for this purpose.

Laboratory investigations on the conversion products obtained in the synthesis of urea have furnished data, from the determination of a melting-point diagram, of solubilities and of vapor pressures, indicating the conditions necessary for the separation of urea from the unconverted ammonia, carbon dioxide, and other products. The relatively low vapor pressures of the mixtures with excess ammonia present and the low freezing point indicated the possibility of transporting the liquid for use in the preparation of mixed fertilizers. A solution of this character modified by the addition of water, thus further reducing the vapor pressure and freezing point, is being produced commercially for the direct ammoniation of superphosphates. In this way there is obtained a product with higher nitrogen content than is otherwise possible by direct ammoniation.

PEAT AS A NITROGEN CARRIER

A recent development in the utilization of ammonia for the production of a fertilizer material is the treatment of peat with ammonia to form a product with a nitrogen content in some cases as high as 20 percent, part of which is in the form of water-soluble, and part in the form of water-insoluble, nitrogen compounds. Experiments have been conducted by heating peat at temperatures from 30° to 300° C. with ammonia in a closed vessel, and the effect of moisture present, of pressures, and time of treatment have been studied. With the types of peat investigated the increase in temperature had a marked effect in increasing the nitrogen content of the product. A maximum nitrogen content was obtained with peat containing about 10 percent of moisture, but heating beyond 20 hours had little effect in adding more nitrogen.

The product obtained possesses general physical characteristics which indicate that it would be a valuable conditioner in mixed fertilizers, and as such would prevent caking of mixtures on storage and would cause maintenance of a condition suitable for easy distribution in the field. The portion of nitrogen insoluble in water should be retained in the soil for some time and should supplement the more readily soluble materials. This would tend to lessen the loss of nitrogen through drainage or leaching from certain soils where heavy applications of fertilizers are employed.

General considerations of the abundance and cheapness of both peat and ammonia give promise of its commercial production at a price comparable to that of inorganic nitrogen carriers. Since organic nitrogen generally sells at a premium and the price in some cases amounts to three times that paid for

nitrogen as ammonium sulphate, this development would result in a large annual saving and at the same time release for feeding purposes some of the high protein materials such as cottonseed meal and blood.

BIOCHEMICAL AND ORGANIC INVESTIGATIONS

Much progress has been made during the past year in ascertaining the properties of the nitrogen-fixing enzyme, present in *Azotobacter*, which has been termed "azotase". It has been shown that it is active only at a pH above about 6.0. The variations in the rate of fixation with nitrogen pressure have been shown to be independent of temperature, pH, and calcium, strontium, or oxalate concentration. The optimum oxidation-reduction potential of the medium must be somewhat lower for nitrogen fixation than for nitrate reduction or growth.

Other studies with *Azotobacter* have shown that, contrary to reports in the literature, these organisms can live and grow at a pH of less than 6.0, provided they have a supply of fixed nitrogen available. This explains why they may sometimes be found in acid soils.

The influence of carbon dioxide upon *Azotobacter* has been studied and quantitative methods developed which should be useful in studying various organisms of interest in soil, dairy, medical, and even industrial processes. A carbon dioxide requirement by *Azotobacter* which is clearly distinguishable from simple stimulation or utilization as a source of carbon has been shown to exist. The maximum effect on growth and nitrogen fixation is attained at a pressure of carbon dioxide approximating that in air.

Previous work with humates prepared from soil had shown that the stimulating effect of these on nitrogen-fixing bacteria, as well as on the growth of higher plants, is due to the mineral elements, principally iron, held in a readily available form. During the past year, new methods have been devised for the preparation of synthetic and natural humates containing various metals, the inorganic salts of which are ordinarily insoluble in culture media. The efficiency of the process of adding these elements to humate has been increased to nearly 100 percent as compared to 1 or 2 percent formerly obtained. The method of preparing synthetic humate from carbohydrates, such as glucose, starch, molasses, cellulose, or sawdust, has likewise been greatly improved. A number of samples have been prepared for various investigators at their request.

A study of the cause of decreased nodule formation on legumes supplied with combined nitrogen has shown beyond a reasonable degree of doubt that the effect is due to inadequate carbohydrate supply. In the presence of an abundance of nitrogen the photosynthetic carbohydrate is used almost entirely for top growth, thus greatly reducing the supply that reaches the roots. This lack of energy materials in the presence of nitrogenous compounds prevents the roots from growing rapidly. Under the same conditions nodules either fail to develop or grow to only a limited extent for the same reason. Experimentally, it was observed that the addition of sucrose to the roots of alfalfa seedlings, supplied with nitrates, tended to counteract the harmful effect of the nitrates on nodule formation. The nodule bacteria play a very secondary role in the phenomenon.

In the study of the nitrogenous compounds present in *Azotobacter*, nucleic acid, consisting of nitrogenous bases, sugar, phosphoric acid, and some iron, has been separated. It differs from the nucleic acids found in other kinds of living matter, principally in the fact that the nitrogen content of the nitrogenous bases is lower.

Considerable progress has been made in the investigations on the direct combination of nitrogen and organic compounds. Nitrogen in an activated form was found to combine with certain types of substances to yield a variety of highly nitrogenous bases.

POTASH

Particular attention has been devoted to that phase of the potash problem designed to provide cheap potash for the Middle West and Northwest from the abundant volcanic lavas of Wyoming. These deposits are fortunately situated closely contiguous to the world's greatest known phosphate deposits located in Wyoming, Utah, Idaho, and Montana, and contiguous to cheap coal and other

raw materials, thus affording very advantageous conditions for the low-cost production of both potash and phosphates. Methods under development provide means for their combination as potassium phosphate in a form which carries a low distribution charge because of its high plant-food concentration. The territory to be served is now lacking in adequate quantities of both of these essential plant foods. These investigations therefore involve not only the establishment of new, noncompetitive industries, with opportunities for employment, but relate to an essential aspect of profitable agriculture and land utilization.

Toward the close of the year, attention was concentrated on those aspects of the potash problem which have particular pertinence to the Muscle Shoals fertilizer program in order to provide information concerning the production of diversified, high-analysis potash salts, such as the sulphate, phosphate, and nitrate, from the purchasable domestic muriate, or from the naturally occurring potash raw materials in the vicinity of the Tennessee Valley, notably the potash shales.

The application of the various commercial acids, such as nitric, hydrochloric, sulphuric, and hydrofluoric, to the more abundant potash materials, such as Wyoming leucite, Utah alunite, Georgia shale, and New Jersey greensand, has been studied during the year, and substantial contributions have been made to the pertinent fundamental data and technology. Emphasis is placed on byproducts to share production costs and on high plant-food concentration of the fertilizers produced, to reduce delivery charges.

Smelting methods, particularly when applied to a mutually fluxing mixture of potash and phosphate rocks, offer the unusual advantage of yielding two fertilizer essentials in one operation and are especially applicable in Wyoming and Tennessee where the two raw materials can be economically assembled with accompanying low-cost fuel. The potentialities of this proposal have been greatly enhanced by tests which demonstrate that coke is not an essential fuel, but that local coals can be substituted. The low-temperature carbonization of these coals as a preliminary to their use as blast-furnace fuel greatly enhances the economy attained.

Recent advances in the technology of potash recovery as a byproduct of cement manufacture bring to the fore the importance of conserving the very considerable tonnage of potash now allowed to go to waste in this industry. This amounts to approximately 85,000 tons (K_2O) annually in normal years and is subject to a marked increase through slight modification in process. Such potash has the dual advantage of being a byproduct of present wide distribution, and of being of sufficiently small unit output to find ready local markets.

Attention has been given to the utilization of the high-grade potassium chloride produced as a domestic industrial chemical for use in various industries. Consideration has been given to its conversion into other fertilizer salts such as the sulphate, phosphate, and nitrate, in order to enlarge its market and provide a greater variety of potash fertilizers of domestic origin for domestic use.

PHOSPHATES

An extensive study of the occurrence, production, reserves, and chemical composition of phosphate rock in the United States was completed, and the results of this investigation have been reported in a technical bulletin. Aside from its scientific value, this work will serve as a fundamental basis for the more rational utilization of the domestic phosphate deposits.

A study of the action of phosphoric acid on phosphate rock was made. It was shown that the best conversion of the phosphate rock into available forms is obtained with acid containing approximately 50 to 65 percent H_3PO_4. This work is being continued to determine whether the reaction can be accelerated to such an extent that it will be possible to produce concentrated superphosphates and complete fertilizer mixtures in a continuous operation. The treatment of phosphate rock with phosphoric acid seems to offer the best means for the utilization of phosphoric acid produced by acid-decomposition and furnace processes.

Investigations on the removal of fluorine from phosphate rock showed that the fluorine can be completely eliminated by heating the rock at approximately 1,400° C. in an atmosphere of steam in the presence of small quantities of silica.

The important feature of the process is the fact that removal of the fluorine results in the conversion of the phosphate into citrate-soluble (available) forms. The process offers promise as a means for the economical production of phosphate fertilizers similar in properties to basic slag. Also, the product could probably be used as an economical source of phosphate for animal feeding. Nearly all of the fluorine in the phosphate rock can be recovered as a byproduct of the process.

A study is being made of the determination and distribution of water in superphosphates and other phosphate fertilizers. Information on this subject is of fundamental importance in the preparation of fertilizers of good mechanical condition and drilling qualities. A study is also being made of the preparation, properties, and chemical composition and constitution of the complex calcium phosphates. In cooperation with the Arkansas Agricultural Experiment Station, a study was made of the effect on plant growth of calcium and potassium metaphosphates and pyrophosphates and of certain iron and aluminum phosphates.

Improvements in blast-furnace methods of phosphate smelting during the year consisted of an increase in the temperature of the hot blast of about 500° F., which resulted in a saving of fuel and reduced the cost of phosphoric acid. Advances have also been made in the method of cooling the exit gases and of precipitating and collecting the elementary phosphorus therefrom. Special attention is being given to this project in connection with the possible utilization of the Tennessee phosphate-rock deposits by the Tennessee Valley Authority.

MIXED-FERTILIZER TECHNOLOGY

Reference was made in last year's report to the increasing use of the cheaper synthetic materials in mixed fertilizers. Many of these materials differ greatly in their chemical and physical properties from those which they are supplementing or replacing. It thus happens that the mixtures that are now placed on the market show a much wider range of physical properties and of plant-food content than those formerly used. Some of these mixtures have the disadvantages that (1) they undergo leaching or localized concentration in the soil, (2) they cake or become sticky under humid conditions, (3) they contain an unbalanced proportion of the essential plant-food elements, (4) they are acid forming in their influence on soil reactions, and (5) they tend to burn plants unless care is taken to prevent it.

These undesirable properties affect the efficiency of fertilizers by impairing their quality and by interfering with their uniform distribution in the field. The work on mixed fertilizers during the past year has been largely directed toward methods of improving the quality and mechanical properties of fertilizers, particularly those of higher analysis.

Inasmuch as many of the undesirable properties of fertilizers are associated with the soluble components of the mixture, a study has been made of methods for reducing the soluble-salt content of mixed fertilizers. It has been found that the addition of dolomite to a fertilizer mixture not only conditions the mixture and reduces its acid-forming tendency, but also decreases its solubility by forming the available, but slowly soluble substance, magnesium ammonium phosphate.

The quality as well as the physical properties of a fertilizer mixture may change on storage as a result of chemical reactions which take place between some of the newer materials now used in fertilizers and the other components of the mixture. It has been found, for example, that urea reacts with gypsum and monocalcium phosphate, the principal components of superphosphate, to set free water of crystallization and form the complex compounds, calcium sulphate-urea and urea phosphate. The monocalcium phosphate and urea also dissolve in the water set free to form a saturated solution of very low vapor pressure.

The resulting mixture is therefore very hygroscopic and of exceptionally poor drillability. The conditions are very different if the superphosphate is ammoniated before the addition of the urea, or if the urea is added in the form of urea-ammonia liquor. The monocalcium phosphate is then changed into dicalcium phosphate and monoammonium phosphate. Neither of these compounds increases the hygroscopicity of urea or reacts with it to any appreciable extent.

The mechanical properties of a superphosphate that has been treated with urea-ammonia liquor are therefore superior to one that has been mixed with the corresponding quantity of solid urea.

The ammonia-nitrogen content of the mixed fertilizers of this country has increased 155 percent since 1913, whereas that of nitrate nitrogen has decreased 40 percent. The former is acid forming in its influence on the soil reaction and the latter is basic. Most of the fertilizers in use at present are therefore more acid forming than formerly. With a view to the preparation of nonacid-forming fertilizers, a study was made of the reactions which take place when such basic materials as calcium carbonate, limestone, and dolomite are included in fertilizer mixtures of different types. The reactions were found to vary according to whether the phosphatic component of the mixture was superphosphate or ammonium phosphate. All three liming materials react with superphosphate to evolve carbon dioxide. The first two also react to reduce the availability of the superphosphate, but the action of the dolomite in this respect is slight.

Carbon dioxide is also set free when calcium carbonate or limestone is included in fertilizer mixtures containing monoammonium phosphate. As the reaction proceeds the mixture becomes alkaline in reaction and, if the carbonate present is sufficient to give a nonacid-forming mixture, loss of ammonia also takes place. There is little or no loss of ammonia, however, when the limestone or carbonate is replaced with dolomite.

Superphosphate and double superphosphate are examples of fertilizer materials that differ only in the content of one inert component. The first, having a plant-food content of 16–20 percent, is classed as an ordinary or low-analysis material, whereas the second, having a plant-food content of 45–48 percent, is a concentrated or high-analysis product. The use of double superphosphate thus affords a means of preparing a series of concentrated fertilizer mixtures that have the same plant-food elements in the same proportions and combinations as do the ordinary mixtures made from superphosphate. Fertilizer formulas have been developed for the preparation of concentrated mixtures of this type that are greatly superior in quality and drillability to many of the concentrated mixtures now on the market. A study has also been made of the reactions involved and the best technic to be followed in the ammoniation of double superphosphate.

Statistics have been compiled which show that the average mixed fertilizer sold in the United States in 1913 contained 2.2 percent N, 8.9 percent P_2O_5, and 3.9 percent K_2O, or a total of 15.0 percent of plant food. In 1931 the concentration of mixed fertilizers had increased, so that the average analysis formula was 3.3–9.5–5.1, making a total of 17.9 percent of plant food. If no filler had been used in making these mixtures they would have contained an average of 16.6 percent of plant food in 1913 and 21.1 percent in 1931. The data compiled also show the kinds of fertilizers used in each State over the last 50 years. In most States the concentration of the fertilizers consumed has increased as the materials available permitted but, in a few, more and more filler has been used so as to continue to provide the farmer with the same grade of goods he has been accustomed to buying.

The field tests on the effect of particle size on the efficiency of fertilizers are being continued. They indicate greater leaching of nitrogen and reversion of phosphate from the smaller-sized particles. On the other hand, under certain conditions of rainfall, the smaller-sized particles proved more efficient because of greater availability to the plant.

INFORMATION AND EDITORIAL SERVICE

In addition to the technical bulletins, soil surveys, circulars, and other official publications listed below, more than 150 articles on various phases of the Bureau's work have been published in outside journals and periodicals during the past fiscal year. These articles have, for the most part, supplied technical information of value to scientists and, in other cases, have interpreted to farmers and the general public important phases of the Bureau's work. In cooperation with the press service of the Department, the Bureau has furnished newspapers with timely information on practical problems of agriculture and utilization of farm products.

PUBLICATIONS OF THE BUREAU OF CHEMISTRY AND SOILS ISSUED DURING THE YEAR JULY 1, 1932, TO JUNE 30, 1933

TECHNICAL BULLETINS

No. 315. Soil Survey (Reconnaissance) of St. Croix Island, Virgin Islands.

No. 334. The Effect of Inorganic Acids on the Physical Properties of Waterleaf Rag Bond Paper.

No. 335. Fertilizers for Sweetpotatoes Based on Investigations in North Carolina.

No. 344. Petrographic Methods for Soil Laboratories.

CIRCULAR

No. 264. Mechanical Application of Fertilizers to Cotton in South Carolina, 1931. (Joint publication with Bureau of Agricultural Engineering and National Fertilizer Association.)

JOURNAL OF AGRICULTURAL RESEARCH ARTICLES

Differences in the Amino Acid Content of the Chief Protein (Glycinin) from Seeds of Several Varieties of Soybean.

Oil Content of Nine Varieties of Soybean and the Characteristics of the Extracted Oils.

A Method for Determining the Quantity of Mineral Oil Retained by Leaf Surfaces after Spraying. (With the assistance of the Bureau of Entomology.)

Base-Exchange Modifications of a Leonardtown Silt Loam Under Fertilizer and Crop Control.

Progressive Changes in the Cuticle of Apples During Growth and Storage. (Joint Publication with Bureau of Plant Industry.)

The Possible Effect of Hydrogen-ion Concentration on the Absorption of Potassium and Phosphorus by Wheat Plants under Field Conditions.

Chemical Composition of Native Alaskan Hays Harvested at Different Periods of Growth.

SOIL SURVEYS

Basin area, Wyo.
Branch County, Mich.
Calhoun County, Iowa.
Caroline County, Md.
Chippewa County, Mich.
Fort Sumner area, N.Mex.
Franklin County, Mass.
Gooding area, Idaho.
Greeley area, Colo.
Hampden and Hampshire Counties, Mass.
Hancock County, Miss.
Hart County, Ga.
Kent County, Md.
McIntosh County, Ga.
Milk River area, Mont.
Mille Lacs County, Minn.
Ottawa County, Ohio.
Polk County, Fla.
Rincon area, N.Mex.
Sac County, Iowa.
San Luis Obispo area, Calif.
Shoshone area, Wyo.
Suffolk and Nassau Counties, N.Y.

YEARBOOK ARTICLES

Fertilizer Composition and Placement Play Big Part in Cotton Growing.
Wheat Does Best in Well-Drained, Fertile Loams; Responds to Fertilizer.
Utilization of Fruits and Vegetables Aided by Chemical Discoveries.

U. S. GOVERNMENT PRINTING OFFICE: 1933

For sale by the Superintendent of Documents, Washington, D.C. - - - - - - Price 5 cents

REPORT OF THE CHIEF OF THE BUREAU OF DAIRY INDUSTRY, 1933

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF DAIRY INDUSTRY,
Washington, D.C., September 12, 1933.

SIR: I submit herewith a report of the work of the Bureau of Dairy Industry for the fiscal year ended June 30, 1933.

Respectfully,

O. E. REED, *Chief.*

Hon. HENRY A. WALLACE,
Secretary of Agriculture.

The immediate problem of the dairy industry is to regulate total milk production to current demand. It is variously estimated that a reduction of between 5 and 15 percent would greatly improve the present situation. Such a reduction could be made with profit on many individual dairy farms whether demanded by a Nation-wide control program or not. The research work of the Bureau provides information on herd management, feeding, and breeding, which many farmers should find helpful in producing milk more economically. It is possible by lowering the cost of production and by increasing the efficiency of the producing units to obtain greater profit, even with a reduced production.

One of the speediest ways for many individual dairy farmers to reduce the total output from their herds and at the same time profit by such reduction is by culling out the unprofitable cows. Studies year after year of the records of production, feed cost, and income in individual herds in dairy herd improvement associations have indicated the wisdom of keeping accurate records and of constantly culling on the basis of such records to improve the efficiency of the herd. These records furnish numerous examples of herds in which culling has resulted in greater net returns from the herd, even though the size of the herd and the total quantity of milk produced is reduced as a result. Eliminating the lowest producing 10 percent of all milk cows in the country would reduce total production by about 5 percent, and eliminating the lowest producing 20 percent would reduce production about 12 percent. But until a great many more dairy farmers keep records and cull the unprofitable cows from the herd, these cows and their potentially unprofitable offspring will continue to aggravate the troubles of the industry.

It would be possible, also, on many individual dairy farms, to produce a smaller quantity of milk and at a greater profit by changing the farming and feeding system to one in which most of the land would be kept in permanent pastures and legumes, and very little, if any, grain would be fed. The pastures and the roughage would be the basal ration, and grain would be fed only when the resulting increase in production could be obtained at a profit. When prices for milk and butterfat were low, more dependence would be put on the roughage ration, with a lower but more profitable production. Usually the cost of producing the necessary feed nutrients in the form of roughage is so much less than in the form of grain that the dairy farmer who grows all the feed for his cows will make more money if he grows and feeds it in the form of roughage. The lower cost of producing and feeding a roughage ration will more than offset the lower milk yield, especially when prices for dairy products are low.

While the present plight of the dairy farmer would undoubtedly be alleviated by a successful Nation-wide campaign to reduce production, the development of the dairy industry on a permanently sound basis requires the solution of numerous

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problems of fundamental importance in the production and distribution of milk and its various products. An increased consumption of dairy products would benefit the consumer from the standpoint of nutrition and health, and it would improve the economic position of the dairy farmer. Accordingly, the Bureau is giving considerable attention to the problem of improving the quality of all dairy products, both on the farm and in the factory, in order to increase consumption, and to other problems involved in the economical handling, distributing, and processing of dairy products in order to reduce their cost to the consumer. The economical utilization of dairy byproducts presents additional problems for solution. The progress made along these various lines of research and service is summarized in the following pages.

DIVISION OF DAIRY RESEARCH LABORATORIES

L. A. Rogers, *in Charge*

NUTRITION OF DAIRY COWS

In some of the earlier work of this laboratory results were obtained which indicated that in the passage of blood through the mammary gland gluthathione was removed, presumably for use in building up the sulphur compounds of the milk. It has been necessary to repeat this work because it was found that the Folin-Looney method, used in the earlier investigation, is not satisfactory for determining gluthathione in the blood; also because blood coming from the mammary gland has been found to contain fewer corpuscles and hence less gluthathione than jugular blood, for reasons not connected with milk secretions.

The bodies of certain animals contain more cystine and cysteine than can be accounted for by the amounts of these amino acids contained in their food. Since it is generally accepted that the animal body cannot synthesize either cystine or cysteine it has been difficult to account for the amount of these compounds known to occur in the body. The explanation for this apparent paradox has been found in the course of the investigations into the nature of the sulphur compounds in milk. Preparations were made in which cystine was combined in such a way that in the usual methods for its determination no cystine appears. By a slightly modified method the nature of the combination was changed and quantitative results for cystine were obtained. This may be taken to indicate that cystine and cysteine actually exist in the feeds, but in a combination in which they are not detected by the accepted methods of analysis.

In the last year an experiment has been completed showing the effect of a long-continued deficiency of calcium and phosphorus in the ration on the calcium and phosphorus content of the body. Three cows, on which a record of the calcium and phosphorus in the ration as well as in the milk excreted had been kept for 5 or 6 years, were slaughtered and the amount of these two elements in the bodies was determined. This determination showed that, while there was a direct relation between the calcium and phosphorus content of the ration and the calcium and phosphorus content of the body and that a partial depletion of the stores in the body took place when the ration was deficient, physiological factors came into play to limit the drain on the body stores. Consequently the variation of these two elements in the body was not so great as might have been expected from the differences known to exist in the rations.

Data have continued to accumulate showing that certain types of roughages are deficient in factors essential to normal growth and reproduction. Cows fed liberal amounts of protein and total digestible nutrients without pasture for long periods suffer from a slight deficiency of vitamin A even when the roughage is good alfalfa. The effects of this deficiency become much more marked with roughages of inferior quality and are especially evident in defective reproduction. Calves fed on milk from cows whose sole roughage is No. 3 timothy show a marked deficiency of vitamin A and usually succumb to pneumonia or other infection. This deficiency may be largely but not completely overcome by feeding good alfalfa hay at an early age, and cod-liver oil entirely overcomes the unfavorable effect of the inferior roughage. After about 6 months of age calves become less sensitive to infections, and the vitamin deficiency is evident only in a retarded growth rate.

The effect of pasture on the vitamin content of the milk is marked and persists for some time after dry feeding is resumed. The yellow color of the fat, which has been found to parallel its vitamin A content, is three times as high on pasture as any value obtained on the best dry feed.

While the major part of the effect of low-grade roughage is very evidently due to lack of vitamin A it is evident that there are still other factors, essential to growth and reproduction, which have not yet been fully determined. Rats, for instance, do not grow or reproduce perfectly on a standard grain ration supplemented by all the known essential dietary factors, but show a marked improvement when alfalfa is added to the ration.

It has been established that an essential factor of unknown nature exists in skim milk and certain liver extracts. When this factor is supplied in the rations of test rats the determination of vitamin A deficiency becomes much more clearly defined than when this unknown factor is lacking.

BACTERIOLOGY AND CHEMISTRY OF MILK

The studies on bacterial spores have been continued, attention being given to the factors which affect the resistance of the spores to heat and especially to their germination to the vegetative stage in which they are easily destroyed. It has been found that the environment in which spores have existed has a distinct effect on their resistance and may explain some of the variable results obtained when preparations that have been naturally infected with spores are processed. Efforts to throw spores into the germinating stage by X-rays, ultraviolet rays, and other physical agencies have not been successful but some results have been obtained which open new lines of attack with some promise of success.

In many bacteriological determinations it is important to distinguish between living and dead cells. Hitherto this has not been possible, but in the last year results have been obtained which indicate that it may be possible to count both the living and the dead cells by microscopic examination. This has been especially valuable in estimating the number of living propionic-acid bacteria in the dried cultures sent to cheese factories. This determination by the usual methods requires at least 10 days but by the new microscopic method may be done in a few minutes.

In cheese making there is an indefinite but well recognized change in the milk, known as ripening, which is manifest by the character of its reaction with rennet. So-called dead milk curdles slowly and produces a soft and unsatisfactory curd. The correction of this condition on standing is usually ascribed to the action of bacteria but results have been obtained which indicate that this change takes place regardless of the action of bacteria and that it is not accompanied by any appreciable change in the reaction or gross composition. Simple methods of measuring the rate of ripening are being developed which it is hoped will make it possible to determine the condition of each batch of milk and to vary the treatment accordingly.

Very satisfactory tests of the practicability of using concentrated frozen milk as a source of table milk have been made by actual trial on ships making long trips to South America. The limiting factor in the length of time the milk may be held in a satisfactory condition is the thickening due to a denaturation of the casein. The time required to produce this reaction is dependent on the degree of concentration of the milk and on the temperature of storage.

Some intensive work has been done on the separation, composition, and properties of the lipoid compounds in milk. The probable importance of phospholipids in determining the physical properties of milk and some of its products justifies a thorough investigation of their relation to other constituents of the milk.

ICE CREAM

In studying the influence of varying factors on the quality of ice cream, and especially on its physical properties, investigators have been hampered by their inability to measure and express in mathematical terms the effects obtained. The sagging-beam method of measuring viscosity of frozen ice cream has been so perfected that it provides a delicate and accurate means of determining the relation of variations in the composition and manufacturing process on the physical properties of the product in the frozen condition. These measurements are made at a constant temperature well below the freezing point of the mixture.

By this means the true functions of gelatin in ice cream have been determined. It appears that the viscosity curve as influenced by increasing amounts of gelatin is not a straight line, as might be expected, but is a compound curve indicating that the gelatin has two distinct effects. The shape of the curve is affected by the temperature and pressure of homogenization and by the composition of the mix. In all cases, however, there are two points on the curve for gelatin concentration at which the optimum effect is produced. The work has shown that with mixes of certain composition, it is easy to entirely counteract the effect of the gelatin by using the wrong homogenization temperature.

OXIDATION OF FATS

An investigation of the effect of various wave lengths of light on the oxidation of fat which was begun a number of years ago has been completed. When proper precautions have been taken to control the intensity of the light transmitted by the colored screens the early results indicating that the greatest acceleration of oxidation was in the red band and the least effect in the blue have been confirmed. The effect varies somewhat with different oils. The oxidation of cottonseed oil and of lard, for instance, shows the greatest acceleration in the red end of the spectrum while butterfat is most affected by the green and yellow bands. In every case the blue band gave the greatest protection.

Investigations into the factors influencing the rate of oxidation of fat through the measurement of the rate of peroxide formation have tended to confirm conclusions reached by less exact methods. At −10° C. no oxidation of cottonseed oil could be detected in 90 days but at 10° oxidation was greatly accelerated. The presence or absence of oxygen in the container had much less influence on the rate of oxidation than the temperature.

In attempting to apply these results to pure butterfat contradictory results have been obtained which may indicate that some butterfats have a natural protection against oxidation which renders them exceptionally resistant to deterioration.

BYPRODUCTS

WHEY ALBUMIN

The investigation on methods of separating albumin from the other constituents of whey has been finished with the completion of an apparatus by which the greater part of the salts of concentrated whey may be efficiently removed by electric dialysis. While this does not give a pure lactalbumin, a powder is obtained with a high content of albumin with its natural properties unimpaired. Incidentally an apparatus has been devised for electrodialysis on a relatively large scale for which many applications in the industries are likely to be found.

LACTOSE

In order to reduce the cost of lactose sufficiently to permit its technical use in competition with other sugars, it has seemed necessary to devise a process by which a sugar of sufficient purity could be obtained in one crystallization. The high price of the pharmaceutical grade of lactose is in a large measure due to the second crystallization, which not only adds to the cost of manufacture but reduces the yield. A method was devised by which a sugar of satisfactory composition for technical purposes could be obtained by one crystallization, but it was found that this sugar had such a marked tendency to foam when its solution was boiled that its use for certain purposes was precluded. This foaming was found to be caused by a small amount of protein which was adsorbed on the crystals and could only be removed by excessive washing. This difficulty has been overcome by subjecting the whey to a digestion which converts the protein into a form in which it is removed with the mother liquor. Incidentally, this digestion so changes the physical properties of the whey that it is possible to concentrate it in a multiple-effect vacuum pan, thus reducing the amount of steam required for evaporation more than 50 percent below the requirements of the ordinary single-effect pan.

An extensive investigation of the dietary value of lactose in comparison with sucrose has been completed. Results obtained with white rats have been confirmed with pigs through the cooperation of the Bureau of Animal Industry. When lactose or sucrose was fed in unrestricted quantities the rats fed lactose grew the faster at the beginning, but with advancing age the rats fed sucrose became distinctly the heavier. In this group the rats fed lactose, almost without exception, lived longer than their litter mates fed sucrose. In lots in which the feeding was controlled so that an equal weight of food was consumed by each rat of the pair the difference was not so marked, but in all cases both with the rats and the pigs the tissue of the animal fed sucrose contained a higher percentage of fat than the corresponding animal obtaining carbohydrate in the form of lactose. When the sugar fed amounted to as much as 45 percent of the ration there was a tendency for the lactose ration to produce a diarrhea with a consequent retardation of growth. This effect eventually disappeared and the rats grew normally. Sucrose did not have this effect.

In view of the possible use of lactose to replace some of the sucrose in jams and other food products, determinations have been made of the osmotic pressure of

lactose solutions. These show that, on theoretical grounds at least, lactose should have a preserving effect, within the limit of its solubility, equal to cane sugar.

CASEIN

Cooperative work with the Bureau of Standards and with the paper-coating industry developed the fact that one of the chief defects encountered in paper-coating is the tendency of some lots of casein to foam excessively when the slip is spread on the paper. This causes uneven coating and spots where the coating is entirely lacking. The tendency to foam can be corrected to some extent by foam removers, but good caseins cannot be made to foam by any manipulation of the slip. It was found that while various factors in the manufacturing process had some influence on the tendency of the casein to foam, the major cause is the use of low temperatures in the precipitation. With proper regulation of the precipitation there is little difficulty in making casein free from this defect. By blending a casein of good quality with caseins that have a tendency to make foaming slips, the tendency can be entirely overcome. A small amount of good casein is sufficient to correct a relatively large amount of inferior casein.

A large number of lots of casein have been made, using wide variations in the manufacturing process; and the caseins have been tested for coating properties on a miniature coating machine in the laboratory. These tests have established the limits within which casein making can be varied without seriously affecting the quality of the product.

The obviously economical source of casein would be buttermilk, which is available in large quantities at a low value. It is very difficult to make a satisfactory casein from buttermilk under any circumstances and it has been a question whether this was because of impurities in the casein, especially fat and ash, or whether the casein itself no longer had the properties essential to technical use. In consideration of the improvements in technic which have been made since the buttermilk-casein problem was last investigated it was decided to make at least some exploratory studies. These have progressed enough to make it evident that the casein in buttermilk is not changed in any essential manner, but no practical method has yet been devised for removing the impurities which are the evident cause of the inferiority of the casein.

Investigations have been continued, as time has permitted, on the problem of converting casein and lactose into resins, lacquers, and similar products which are used in the arts. While nothing of definite value has been obtained, some of the results are sufficiently promising to warrant a continuation of the work.

CHEESE

The essential part of the investigations on Swiss cheese may now be considered as completed, although certain details remain to be cleared up. The results of these investigations which have extended over a number of years may be summarized as follows: The condition of the milk is very important, not only in excluding resistant gas-forming bacteria but also in securing a certain "ripeness" which is necessary to a satisfactory condition of the curd. Tests by which this can be controlled have been developed.

Centrifuging the milk causes changes, not yet fully explained, which have a favorable effect on the eye formation. Cheeses made from clarified milk have fewer and larger eyes than cheeses made from unclarified milk.

The essential factor in the production of cheese with the required eyes, flavor, and texture is the control of the bacteria which bring about the normal ripening. Not only must these bacteria be present in the milk but the making process must be carefully adjusted to insure their development at the proper time and in the proper sequence. At least 3 and probably 4 types of bacteria play major roles in the ripening process. The milk in the kettle and the curd for a few hours after it is put in the press are at a temperature too high for the growth of ordinary bacteria but in this stage a thermophilic streptococcus begins the task of converting the lactose to acid. When the temperature drops to a certain point this work is taken up by the lactobacilli which complete the conversion of the lactose to lactates. The orderly progress of this process is very essential and it is necessary to prepare the cultures with great care to insure their prompt growth when the temperature makes growth possible. The progress of this process can be followed by determining the hydrogen-ion concentration at intervals, or by simple empirical tests.

These bacteria, by rapidly increasing the acidity of the curd, prevent the development of bacteria which produce abnormal fermentations and at the same time

prepare the curd for the work of the true ripening bacteria which convert the lactates into propionates and carbon dioxide. These ripening bacteria give the cheese its characteristic flavor and eyes. One culture which has been used for some time as one of the three starters added to the milk is efficacious in producing the characteristic sweetish flavor and has some part in forming the eyes, but work in the last year has indicated that other bacteria of the same type may be of sufficient importance in controlling the eye formation to warrant their addition to the three cultures now regularly employed.

The control of the cultures and the manufacturing process is now so exact that it is safe to say that, in nearly all cases, defective cheeses are the direct result of failure to follow the indicated procedure in detail.

The methods developed in the laboratory are now coming into general use. Clarification of the milk is almost universal and a large number of factories now use the pure cultures in some form. Cultures for over 18,000 cheeses were distributed last year from these laboratories in addition to those furnished Wisconsin factories through the cooperative arrangement with the University of Wisconsin.

There still remains for investigation the possibility of still further controlling the Swiss-cheese process by pasteurization. Pasteurization has been used with some measure of success in the past, but with the control of bacteriological conditions now available it should be possible to still further standardize the making of this type of cheese.

Research work has been started on the ripening of Cheddar cheese made from pasteurized milk. Thus far the work has been of a preliminary nature, but results already obtained indicate that this will be profitable research.

The investigation on the canning of Cheddar cheese is completed. Equipment has been developed for pressing and cutting cheese of a small diameter and a lot of nine thousand 12-ounce cheeses have been put in cans for ripening at the Grove City Creamery.

The Roquefort-cheese investigations may also be considered as completed. The quality of cheese obtained in the last 2 years at the Grove City factory has proved that with proper control of the temperature and humidity of the curing rooms it is possible to make uniformly a cheese which compares favorably with the best imported product. The commercial production of this cheese under domestic conditions is now a marketing problem. Work in the last year on making Roquefort from pasteurized milk has shown that while it may be possible to make a satisfactory cheese in this way, the pasteurized-milk cheeses have, on the whole, been distinctly inferior to those made from raw milk. Very satisfactory results have been obtained by sealing the cheeses in cans and storing at low temperature. This preserves the color and general condition of the cheese and makes a convenient package for shipping.

BREEDING, FEEDING, AND MANAGEMENT INVESTIGATIONS

R. R. Graves, *in Charge*

THE EXPERIMENTAL BREEDING HERDS AT BELTSVILLE, MD.

PROGRESS OF LINEBREEDING-OUTBREEDING PROJECT WITH HOLSTEIN-FRIESIAN CATTLE

Fourteen of the thirty-six daughters of Denton Colantha Sir Rag Apple, sire of the first outbred generation, are still in the herd. All but six have completed their mature production records. The second unrelated proved sire, Varsity Derby Matador, has 27 outbred and 5 inbred daughters in the herd. The third proved sire has 9 and the fourth has 5 daughters in the herd. All the above sires are dead. Chief Piebe Ormsby Burke is the fifth unrelated proved sire on the project, and is now in service. The progeny of the above sires are members of the first, second, third, and fourth generations of outbreeding.

The first linebred generation now numbers 22 females and there are 6 heifers in the second linebred generation.

PROGRESS OF INBREEDING-OUTBREEDING PROJECT WITH JERSEY CATTLE

The Owl-Interest group is made up of 7 daughters of The Moose o'Fernwood, 2 daughters of Double Moose of Sophieson, and 12 daughters of Oxford May's Interest Owl. Three of these are inbred. Marston's Interested Owl is the sire now in service in this group.

The Sophie Tormentor group consists of 2 daughters of Hood's Sophie's Tormentor, 13 daughters of Sophie's Torono 23d, 2 daughters of Sophie's Torono Noble Fern, and 12 daughters of Sophie's Phoenix, the sire now in service. Five of the above are inbred.

In the Raleigh group are 1 daughter of Karnak's Noble 4th, 5 daughters of Tiddledywink's Raleigh, and 7 daughters of Raleigh's Dorothy's Senator, the present herd sire.

PROGRESS OF THE FAMILY-CROSSING EXPERIMENT WITH JERSEY CATTLE

Fifteen females on this project are now at Lewisburg, Tenn. In the Beltsville herd there are 1 male and 1 female in the 2-family group, 4 males and 15 females in the 4-family group, 3 females representing the 6-family combinations, and 3 females descended from 8 distinct families.

OFFICIAL TESTING

Five mature Holstein cows completed production records during the year, averaging 18,252 pounds of milk and 624 pounds of butterfat in 365 days. Eight first-calf heifers, calving at the average age of 2 years 2 months, completed records that averaged 12,143 pounds of milk and 448 pounds of butterfat. One hundred Holstein cows have now completed 151 records that average 16,138 pounds of milk and 559 pounds of butterfat.

Four mature Jersey cows completed production records during the year, averaging 12,662 pounds of milk and 701 pounds of butterfat; and 6 first-calf heifers, calving at the average age of 2 years 3 months, made records averaging 7,896 pounds of milk and 446 pounds of butterfat. One hundred and twenty-four Jersey cows have now completed 176 records that average 10,048 pounds of milk and 545 pounds of butterfat.

PROVING BULLS

Fifty-four Holstein bulls and 48 Jersey bulls were in service in herds of cooperators to be proved for their ability to transmit milk and butterfat production. This number of bulls is only slightly less than the number a year ago, and very few new cooperators were added to the list during the year.

RELATION OF THE CONFORMATION AND ANATOMY OF THE DAIRY COW TO HER MILK AND BUTTERFAT PRODUCING CAPACITY

ANTE-MORTEM AND POST-MORTEM STUDIES

The study of the interrelation between external form, internal anatomy, and producing capacity involves the measurement of conformation and the slaughter and anatomical study of cows whose producing capacity has been demonstrated. Nineteen State experiment stations are cooperating with the Bureau on this project. Reports on 60 cows were made during the year. There are 461 reports now on file. In addition, similar anatomical studies were made during the year at the Beltsville station on 7 bulls, 14 heifers, and 2 freemartins.

During the year the forms used in recording data were revised to provide for a number of items such as weight of parathyroids, weight and measurements of pineal, and measurements of pituitary body and of ovaries, as a part of the regular anatomical studies of all stations. In addition, the diameter of intestines is now measured for all cows slaughtered at Beltsville. A report showing the average and the range of data for each ante-mortem and each post-mortem item for the first 318 cows slaughtered in this study has recently been published.

CONFORMATION AND GROWTH

The study of growth and the changes taking place in the conformation of animals throughout their life has been continued, with the addition of 277 sets of measurements and contours on 179 different females, and 5 sets on males. This brings the total number of sets on file to 1,932 on females and 42 on males. Measurement records have now been completed to maturity on 57 different cows. Ten of these were completed during the year. Areas, volumes, body proportions, and factors based on the interrelations of the body measurements and contours have been determined for future analysis.

Four hundred and thirty photographs, taken for the purpose of recording body development and conformation at definite ages from birth to 1 year of age, have been added to the files. Of this number 281 were of heifers and 149 were of bulls.

MAMMARY-GLAND STUDIES

The previously outlined plan of studying the udder through its different periods of development and activity, and after death, that has been in progress for several years, has been continued. During the year 331 udder observations were made on heifers ranging in age from birth to 12 months, 32 on heifers at 18 months of age, and 838 on cows. In addition 174 observations were made on the rudimentary mammary development of bulls ranging in age from birth to 12 months.

On the basis of all observations on the udder development of heifer calves made to March 31, 1933, standards for udder development have been established for the ages of 2 weeks, 1, 2, 3, 4, 5, 6, 9, 12, and 18 months for Holsteins and Jerseys. These standards provide a basis for determining whether the udder development of a heifer is advanced or retarded at any age, and eventually will show whether or not advanced mammary development at a given age is significant of capacity for high production.

Udder capacities were measured for 10 lactating cows, 17 nonlactating cows, 6 cows and heifers that never had been pregnant, 2 freemartins, and 11 calves ranging up to 12 months of age, by measuring the quantity of fluid the udders would hold. In addition the udder capacity of two ewes was measured in a study of the comparative mammary structure of different species of domestic animals. The average udder capacity was 43.83 pounds for the 10 lactating cows, 28.98 pounds for the 17 nonlactating cows, 9.69 pounds for the 6 cows and heifers that had never been pregnant, 0.13 pound for the 2 freemartins, and 1.56 pounds for the 11 calves. The capacities for the 2 ewes averaged 2.56 pounds. The total number of udder capacities determined to date is 188.

Sectioning of the udders and photographing of the sections was completed for 32 cow udders. The histological study of udder tissue from 26 cows, 2 ewes, and 4 heifers and calves is in progress, and material has been made available for the histological study of the mammary tissue of 11 other heifers and 8 bulls. The udders of 18 heifers and calves have been studied by dissecting out one half and freezing the other half for gross and histological study. Sixteen of these specimens were photographed. The dissected specimens have been preserved to illustrate the different stages in the development of the mammary gland. The genital organs also have been preserved to illustrate the genital development at different ages. In addition the rudimentary mammary development of eight bulls has been studied by dissecting and photographing one half. Studies of the physical properties of mammary tissue have been completed on three udders and commenced on a number of others. The porosity and fluid-carrying capacity of different udders and of different areas in the same udder have been found to vary greatly.

MILKING STUDIES

The study of the rate at which the milk is drawn from individual cows when milked by machine has been continued. To date 260 timings on 198 cows have been made at, or near, the third month of lactation, and 261 timings at different stages of lactation on 53 cows. Extreme differences in rate have been found between individual cows. Work has been commenced to determine the quantity of milk secreted by each quarter of the udder and the rapidity with which it can be drawn from each quarter. Corresponding milkings on successive days have given surprisingly similar results.

HEALTH AND FERTILITY STUDIES IN THE BELTSVILLE HERDS

HEALTH OF THE HERDS

In June 1932, two females in the abortion-negative herd became positive to the agglutination test for abortion disease and were transferred to the abortion-positive herd. No other reactors have been found. The abortion-positive herd now consists of 48 females, all of breeding age, and the abortion-negative herd consists of 260 females, 190 of which are of breeding age.

The herds continued to be free of tuberculin reactors, as they have been for many years. Only one animal died as a result of foreign bodies in the feed this year; and there were no occurrences of fat necrosis tumors, a condition that has given some trouble in other years. Several calves were lost as a result of digestive disturbances, but most of them were on various kinds of feeding experiments.

BREEDING EFFICIENCY

The cows in the abortion-free herd continue to have a higher breeding efficiency than the cows in the abortion-positive herd, when measured by both the number of cows that were bred and that conceived and by the number of services required per conception. However, the abortion-free heifers being bred for first calf give more trouble in breeding than do the cows in the abortion-positive herd. Heifers in a number of the Bureau's field station herds that are entirely abortion free, also give a great deal of trouble in conceiving for the first calf. From reports received by the Bureau this seems to be a common trouble throughout the country. Usually such heifers finally conceive, though they require an abnormally large number of services. Out of 142 heifers of one breed at Beltsville, bred for first calf, over a period of years, all but 7 finally conceived. This is a loss of 5 percent.

CALVING EFFICIENCY

In the abortion-free herd 109 pregnancies were terminated during the year, resulting in 93, or 85 percent, normal live calves; 12, or 11 percent, abortions; and 4, or 3.66 percent, calves born dead. Some of these abortions occurred at very early stages, 1 to 3 months, and in most herds would go unnoted. All abortions in this herd, however, resulted from causes other than abortion disease (*Brucella abortus*).

In the abortion-positive herd 49 pregnancies were terminated during the year, resulting in 35, or 71 percent, normal living calves; 12, or 24 percent, abortions; and 2, or 4 percent, calves born dead.

Calves were born dead as a result of abnormal presentations; milk fever in the dam before delivery of the calf; dam too small for passage of calf; and calf being carried 306 days.

STERILITY

Abnormal conditions of the genital tract, found in the animals of the two herds, that were causing breeding troubles were as follows: (1) Persistent corpora lutea interfering with oestrum; 6 cows in abortion-free herd, none in the abortion-positive herd. (2) Ovarian cysts: 2 cows in abortion-free herd, 3 cows in abortion-positive herd. (3) Inflammation of uterus: 8 cows in abortion-free herd, 6 in abortion-positive herd. (4) Reabsorption of fetus: 5 in abortion-free herd, 3 in abortion-positive herd. (5) Infantile uterus: 3 in abortion-free herd, none in the abortion-positive herd. (6) Inflammation of ovaries: 3 in abortion-free herd, and 3 in abortion-positive herd. (7) Cervicitis: 1 in abortion-free herd, none in abortion-positive herd.

Most of the 6 cows having persistent corpora lutea conceived after treatment.

FERTILITY STUDIES

Studies of the morphology of spermatozoa were made during the year from 95 samples of semen. A method of collecting material from the ampullae of the ductus deferens and from the seminal vesicles, free from other secretions, has been developed during the year.

Artificial insemination has been tried in 17 cases. Six of these animals proved to be permanently sterile, and 5 of the other 11 conceived as a result of artificial nsemination. Some improvement in the technic has been developed, which, it is believed will result in a greater degree of success.

FEEDING AND MANAGEMENT INVESTIGATIONS AT BELTSVILLE

Contrary to a widely prevalent opinion, the heavy feeding of protein to milking cows has not led to udder troubles nor to an increase in the numbers of streptococci and cells in the milk.

Results obtained this last year, confirming those previously reported, show that leaving a pound or so of milk in the udder has no adverse effect on the normality of the udder, nor does it cause any consistent difference in the numbers of bacteria and cells in the milk.

Low-producing cows changed from twice-a-day milking to once-a-day milking declined in production at an abnormal rate.

Skim milk was found to be an unsatisfactory feed for dairy cows. The cows did not relish it and they declined rapidly in production.

The content of inorganic phosphorus in blood, as determined by an examination of 69 samples from 12 cows that were fed rations containing different amounts of

phosphorus, indicates that the phosphorus requirements of the dairy cow may be fairly well estimated from the analyses of the feed consumed and the quantity of milk produced.

An investigation was conducted to determine the best method of curing and storing alfalfa hay in order to preserve the natural green color. Samples stored in the absence of light and air and at a temperature near freezing for 8 months lost no color. Samples of artificially dried hay having a low moisture content lost but little color when stored in the absence of light and air and at room temperature; and there was no excessive loss of color when the samples were exposed for 8 months to either diffused sunlight or air, or both. The naturally cured hays possessed less color and more moisture than the artificially dried hays and when stored in the absence of air at room temperature sustained a marked loss of color. Apparently, quick and thorough drying is the main factor in making hay that will have and retain a high color.

The greener the hay the higher is the content of assimilable carotin. This has been shown by the variations in yellowness of the butter from cows fed hays of different quality. Cows fed a good grade of artificially dried alfalfa hay produced butterfat with a higher yellow color than did cows fed naturally cured alfalfa; in fact, the butter from cows fed the good artificially dried alfalfa approached in in color that from cows grazing on Kentucky bluegrass.

In 1932, heavy-milking cows on pasture consumed 150 pounds of grass a day in May, 100 pounds a day during the latter part of June, and only 50 pounds a day in the middle of August. Further results obtained in 1933 indicated that under conditions prevailing at Beltsville the falling off in the rate of consumption as the season advances is due mainly, if not entirely, to the character and abundance of the vegetation.

Two years' work in which two comparable plots of pasture grass were clipped periodically to heights of 1½ and 4 inches, respectively, showed greater yields of both green and dry matter from the closely clipped plot, thus indicating the desirability of close grazing when animals are rotated from one pasture to another.

A complete fertilizer was applied to half of the area in a good small pasture. Observations showed that cows had a slight preference for the grass on the fertilized area.

Liberal applications of nitrogen to pastures at Beltsville, especially in the summer, are of doubtful economic value, (1) because of the cost, and (2) because the growth of legumes is suppressed.

Rotation grazing continues to give greater returns than continuous grazing. Whether this is due to a difference in the productivity of the soil of the two pastures or to the method of grazing is being determined.

PHYSIOLOGICAL RESEARCH AT THE BELTSVILLE LABORATORY

Experiments were started and carried to a successful conclusion on the speed of transport of spermatozoa in the uterine tract of the dog. It was shown that in this species spermatozoa were transported en masse within 30 seconds to the mouth of the oviducts. Thus it is demonstrated that in this species, like in the rat as shown by Hartmann and Ball, uterine peristaltic contractions carry the sperm to the oviduct and that ciliary movement and movement of the spermatozoa themselves play little or no role in the transport of sperm. It is very probable that this method of sperm transport in the dog and the rat accounts for the very high percentage of successful impregnation.

Six experiments with cows demonstrated that much more time is required for spermatozoa to reach the oviducts in the cow than in the dog. A preliminary statement can be made that it is in the neighborhood of the twenty-fourth hour, plus or minus 4 to 6 hours, that the spermatozoa arrive in the oviduct. More exact experiments will be made.

It is clear, however, from the data gathered so far that in the cow the spermatozoa are not transported en masse but make their way by means of their own motion, possibly aided by the movement of the cilia of the uterus, to the mouth of the oviduct.

Effort has been made to preserve bull spermatozoa artificially so that they can be kept for longer periods of time and used later in artificial insemination. The preliminary work has been done on the role of hydrogen-ion concentration of the media and its lethal effect upon sperm cultures. It has been definitely demonstrated that sperm cultures made from the bull show an initial normal pH, and that with increasing periods of time with glycolysis occurring, the pH instead of falling actually rises to approximately pH 8.45. This fact demonstrates that the end product of glycolysis is not lactic acid, or that some other process

takes place which causes the formation of highly alkaline bodies. So far as known, these data offer the first information which may throw light on the cause of death in sperm cultures.

Effort has been made in this laboratory to elucidate the problem of the influence of the anterior pituitary on lactation. Experiments have been made on the preparation of active and highly potent alkaline extracts of the anterior pituitary. These extracts have proved very efficient in initiating milk secretion in cows, goats, dogs, and rabbits. The initial results have been highly satisfactory.

The importance of purifying the anterior-pituitary preparations used for the lactation experiments becomes clear when consideration is given to the independent discovery made in this laboratory that anterior-lobe extracts contain some factor which, when injected into normal dogs, brings about a syndrome characteristic of clinical diabetes. Because of the far-reaching significance of this finding careful watching and checking of all preparations is made for the lactation effect to determine whether or not the diabetogenic factor is being carried along in the experimental procedures.

A very interesting observation has been made on the immediate effect of injecting intravenously a small quantity of anterior-lobe extract. Within 2 or 3 minutes after the injection, the cow begins to dribble milk from all four teats. This phenomenon demonstrates the presence in the extract of some "galactagogue" principle which stimulates the effect of the posterior-pituitary extracts. The question, therefore, is: Do these extracts contain pituitrin, or do they contain some hitherto undescribed galactagogue principle?

WORK AT THE FIELD EXPERIMENT STATIONS

GENERAL

The routine work of the seven field experiment stations has been carried on as formerly. The proved-sire breeding experiments in progress at all stations are gradually showing results. The practice of loaning bulls to cooperators for proving is being gradually curtailed and in the future only a sufficient number of bulls will be raised to serve as replacements, without increasing the number of cooperators. Some of the experimental breeding herds have increased to the point where a reduction in numbers will be made. The seven herds now contain 323 cows and heifers. In addition there are 119 bulls and calves, making a grand total of 442 head. Official testing work has progressed, a total of 55 official records having been completed during the fiscal year. These records average 11,212 pounds of milk and 455 pounds of butterfat at an average age of 2 years 11 months.

Feeding experiments in which cows are fed for entire lactation periods on hay alone to determine the amount and the relative economy of production on different kinds of hay are in progress at all but two stations. Twenty-one cows are now on this type of feeding, 16 of which are being fed alfalfa hay alone, 2 oat hay alone, and 3 Sudan-grass hay alone. To date 12 cows have completed 16 yearly records on alfalfa hay alone, averaging 11,399 pounds of milk and 405 pounds of butterfat, on a mature basis. Their average consumption of alfalfa hay per year was 14,729 pounds. These same cows also made comparable records on full-grain rations, averaging 17,769 pounds of milk and 602 pounds of butterfat. These cows produced only 64 percent as much milk and 67 percent as much butterfat when fed alfalfa hay alone as when fed a full-grain ration, but their returns when fed alfalfa hay alone were $11 per cow above feed cost, whereas their returns when fed the full-grain ration were less than feed cost. These calculations are on the basis of butterfat at 20 cents per pound, alfalfa hay at $10 per ton and grain at $25 per ton.

Studies have been started at all stations in which the actual cost of growing various crops will be kept. The cost of growing 100 pounds of nutrients per acre can then be calculated. Similar studies have been started to determine the man-hours necessary to perform the routine duties in the care and management of the various herds.

MANDAN, N.DAK., STATION

In an experiment on the relative feeding value of oat hay and alfalfa hay two groups of four cows each were fed for approximately 150 days. It was planned to feed the hays in unrestricted quantities and to limit the grain to 75 percent of the cow's grain requirements. The grain was later reduced to 50 per cent of the requirements, and finally eliminated entirely. Difficulty was experienced in

that when the amount of grain was increased to meet requirements the consumption of hay decreased. The experiment did not adequately measure the comparative feeding value of the two hays, but it has furnished some valuable data on the influence of the amount of grain consumed on hay consumption. Two additional cows are being carried for entire lactation periods on oat hay alone.

A portable barn for young cattle was constructed. Seventeen sires are loaned to cooperators.

New experiments leading to better utilization of wild-grass hay have been outlined. Pasture experiments to secure data on the carrying capacity of native grass, bromegrass, and crested wheatgrass have also been started.

HUNTLEY, MONT., STATION

A new seeding of a pasture-grass mixture is now being cut at early stages of maturity and made into hay and silage. This will make it possible to carry out feeding trials with the grass hay and grass silage over long periods. Results of previous work on the feeding value of pasture grasses as grazed, clipped and fed green, and as hay and silage, were published this year. Several very good sires bred at the station were proved during the year.

WOODWARD, OKLA., STATION

As a continuation of the Sudan-grass hay experiments, three cows are being fed for entire lactation periods on Sudan-grass hay cut at the first-heads-out stage. Their production will be compared to that of cows fed alfalfa hay. Plans were made for feeding another group on Sudan-grass silage throughout the year, but dry weather prevailing in this section will prevent the making of Sudan-grass silage.

The daughters of King Paul Helena Walker 348317 continue to produce remarkably well. Twenty registered daughters have now made official production records, averaging 22,563 pounds of milk, 3.23-percent butterfat test, and 737.6 pounds of butterfat, when calculated to a mature basis. The first daughters of Sir Bess Rue North Star 470775, the next proved sire in use at this station, have been bred and will start calving this fall.

A new bull barn and new bull pens were completed during this fiscal year.

JEANERETTE, LA., STATION

The diseased condition of the dairy herd, presumably (nasal granuloma), continues. Investigators working on the problem are of the opinion that probably the disease is of parasitic origin. The heifers are showing symptoms of the disease, and there are four chronic cases among the cows. This disease is probably responsible for a lowered production in the herd and is interfering with experimental work. Some trouble is also being experienced with coccidiosis in the young calves.

Experiments are being continued with the feeding of artificially dried roughages. Five Jersey cows are now being fed for entire lactation periods on artificially dried alfalfa hay. Several pasture experiments are under way.

PONTIAC, S.C. (SAND HILL), STATION

An experiment to determine the feasibility of a rotation of annual crops to furnish grazing throughout the year is under way. Seven 2-acre plots are being used. For winter grazing a mixture of oats, rye, barley, and vetch is being tried. For the balance of the year plots in soybeans, velvetbeans, Sudan grass, lespedeza, and alfalfa are being grazed. The study of the carrying capacity of pastures is being continued.

The feasibility of alfalfa for the sandy soils prevailing in this district is being tried out.

An excellent stand of alfalfa was secured but extreme dry weather late in the summer apparently has resulted in serious injury. From results secured elsewhere in the sand-hill district it appears that alfalfa may be the feed crop that is best adapted to this type of soil.

HANNIBAL, MO., STATION (THE HATCH FARM)

An experiment to determine the yield of pasture grasses and carrying capacity of pasture grass under various systems of fertilization was started last spring. This involves the use of 40 plots, each plot being 11 feet wide and 39.6 feet long. Various fertilizers, singly and in combination, are being applied. The plots are clipped periodically, the grass is weighed and will be chemically analyzed.

Use of the new milking barn and milker was started in February.

Peggy's Majestic Duke 259690, a proved Jersey bull, was leased in March and is now in service. Lady's Rinda St. Mawes 226037, a proved Jersey bull, died in June as the result of an injury.

LEWISBURG, TENN., STATION

Roughage feeding experiments with cows and heifers are being continued. An experiment to show the comparative effect of artificially dried and naturally cured hay on the carotin content of the butter produced is also in progress and is showing interesting results.

Breeding troubles have been experienced in the herd, especially with the heifers. Mastitis is also giving some trouble in the milking herd.

A good deal of work was done on the station farm this past year to check and control erosion. Erosion on many of the fields having considerable slope has been quite serious. The Bureau of Agricultural Engineering has made a detailed survey of the farm and furnished plans for terracing.

The experimental work on artificial drying of roughages is progressing but has not proceeded as rapidly as desired because of a shortage of crops for drying, the result of a series of drouths. Some artificially dried legumes have been shipped to the Beltsville station during the last 2 years for experimental feeding.

DIVISION OF MARKET-MILK INVESTIGATIONS

ERNEST KELLY, *in Charge*

CHOCOLATE-FLAVORED MILK

Work has been continued on chocolate-flavored milk, a total of 37 different experiments having been made for the year. Of these, 22 were concerned directly with the reduction of sediment in the finished product and 15 were intended to establish the preference as to the kinds and proportions of the ingredients.

The attempt has been to find some dairy byproduct or at least an agricultural product to act as a stabilizing agent, or to find some simple mechanical method. So far all methods tried have failed appreciably to reduce the sediment, but some success has been achieved in obtaining a more flocculent sediment, which mixes more readily upon shaking. Seven trials comparing the homogenization of the mixed chocolate-flavored milk and homogenization of the milk alone before adding the sirup have been run. Less shaking was necessary to remix the sediment in all samples where the sirup and the milk were homogenized together. The homogenization of the final product was also better from the standpoint of palatability.

No appreciable benefit resulted from the addition of whey protein powder or dextrin, although the dextrin was the better of the two. Each reduced the amount of shaking necessary to remix the product but the general results did not seem to warrant further use. Clarification proved impractical. Milling the sirup in either a ball mill or a colloid mill increased the volume of sediment but expedited the remixing. Freezing the sirup had the same results as milling but to a lesser degree. A slight advantage was derived by using condensed skim milk in place of fresh skim in making the sirup.

Several trials resulted in finding a formula for the sirup which seemed to be preferred by the majority of those people tasting the chocolate-flavored milk. This formula calls for 2 parts by weight of cocoa, 9 parts of sugar, and 9 parts of skim milk. This is used in the ratio of 1 part by weight of sirup to 10 parts of milk.

A decided preference by the organoleptic test was shown in favor of chocolate-flavored drinks with the higher percentage of butterfat. Comparisons were made between skim milk, 2-percent fat and 4-percent fat. The higher fat content also gave some advantage in sediment control.

HOMOGENIZED MILK

Experimental work has shown what may be termed an optimum temperature range of homogenization, in so far as producing an oxidized flavor is concerned. This temperature range is from 30° to 45° C. (86° to 113° F.). Milk homogenized within this temperature range always developed a strong oxidized flavor within 18 hours after homogenizing. Milk homogenized at 10° C. (50° F.) remained of good flavor for this length of time. However, milk homogenized at 15° C. (59° F.) had begun to develop the flavor, and that homogenized at 20°, 25°, and 55° C. (68°, 77°, and 131° F.) contained the flavor after 18 hours, but

to a lesser degree than that homogenized within the optimum temperature range. The milk homogenized at temperatures from 4.14° to 10° C. (40° to 50° F.) while remaining of good flavor for 18 hours developed an abnormal flavor upon further aging. Milk homogenized at 60° C. (140° F.) did not develop the oxidized flavor.

Further evidence that there is an optimum temperature for this development of the oxidized flavor is shown by the time required for this flavor to develop in milk after homogenizing. When raw milk was homogenized at 3,000 pounds pressure and not cooled after homogenizing, the milk homogenized at 20° C. contained a very slight oxidized flavor, that homogenized at 30° contained a slight oxidized flavor, that homogenized at 40° a very slight oxidized flavor, while that homogenized at 60° was normal in flavor 2 hours after homogenizing. When the milk was cooled at 7° (approximately 45° F.) immediately after homogenizing there was a trace of the oxidized flavor in the milk homogenized at 20° and 30°, while that homogenized at 40° and 60° was of normal flavor 2 hours after homogenizing.

Three hours after homogenizing the milks homogenized at 20°, 30°, and 40° and not cooled after homogenizing, had a pronounced oxidized flavor, while that homogenized at 60° was of normal flavor. When the milk was cooled immediately after homogenizing, that homogenized at 20° and 30° contained a slight oxidized flavor, that homogenized at 40° a trace of the oxidized flavor, while that homogenized at 60° was normal in flavor 3 hours after homogenization.

Four hours after homogenizing, when the milk was not cooled, that homogenized at 20°, 30°, and 40° had a very pronounced oxidized flavor and that homogenized at 50° (122° F.) contained a trace of this flavor. When the milk was cooled after homogenizing, that homogenized at 20° and 30° contained a slight oxidized flavor and that homogenized at 40° had a very slight oxidized flavor.

In each case the cooled samples showed the same oxidized flavor as the uncooled samples within 10 minutes after warming. Cooling only retarded the development of the oxidized flavor.

Varying the pressure of homogenization did not affect the development of the oxidized flavor. If the pressure was sufficiently low to permit a partial separation of the cream, a greater length of time was required for the oxidized flavor to develop and the flavor was less intense.

Inasmuch as raw milk, homogenized at 60°, did not develop an oxidized flavor, the question arose as to whether or not pasteurized milk could be homogenized without danger of causing an abnormal flavor. Pasteurized milk was therefore homogenized through the same temperature range as was used for the raw milk. Upon aging, the milk homogenized at a temperature within the "optimum range" (30° to 45°) for the development of the oxidized flavor, developed what could be identified as a slight oxidized flavor. The milk homogenized at temperatures outside the optimum range did not develop a flavor which could be identified as oxidized. It frequently developed, however, an abnormal flavor sufficiently strong to be objectionable. The pasteurized milk, homogenized at 60° remained of good flavor upon aging.

When the milk was pasteurized immediately after homogenizing, no abnormal flavors developed due to homogenization, regardless of the temperature of homogenization. Likewise, when homogenization immediately followed pasteurization, at the pasteurizing temperature, no abnormal flavors developed.

SPECIFIC GRAVITY OF HOMOGENIZED MILK

It has been determined that homogenization incorporates sufficient air in milk to affect its specific gravity. Homogenization at 3,000 pounds pressure incorporates slightly more air in the milk than homogenization at 1,000 pounds pressure. The air is not permanently incorporated, however, as the difference in the specific gravity of the homogenized and unhomogenized milk becomes less as the milk is aged.

SEDIMENT IN HOMOGENIZED MILK

One of the objections to homogenized milk is that upon standing after bottling a ring of sediment frequently forms on the bottom of the bottle. This sediment, which has the general appearance of separator or clarifier slime, was found to consist largely of leucocytes or body cells. To determine if homogenization of milk permits the cells therein to settle out, the cell counts from different sections of the bottle of homogenized and unhomogenized milk of different ages were made. It was found that in unhomogenized milk the cells are, to a large extent,

carried up with the fat globules and remain in the cream layer. When the milk is homogenized there is no rising of the fat globules, and the body cells, apparently having a higher specific gravity than the milk, when released from the influence of rising fat globules have a tendency to settle to the bottom of the bottle. In this experiment the sediment was pronounced in the milk homogenized at 3,000 pounds pressure, but only slight or absent in the milk homogenized at 1,000 pounds pressure. This was likely due to the fact that the 1,000 pounds pressure permitted the formation of a very thin layer of cream on the top of the bottle, which contained a comparatively large number of body cells.

If the sediment in homogenized milk is due to body cells, clarification of the milk should prevent the sediment. Milk with a high leucocyte count (above 1½ million) was clarified and the experiment repeated. It was found that the same movement of body cells took place in the clarified milk as in the unclarified milk. Although the clarification was not extremely efficient, it prevented the formation of sediment in the bottom of the bottle.

RELATION OF BUTTERFAT CONTENT TO FLAVOR IN STANDARDIZED MILK

The consumer judges milk to a large extent by the cream line which forms in the bottle. The question arises as to whether or not the consumer can detect a lower fat content in standardized milk if he had to rely solely on his sense of taste. To determine the degree with which the fat content of such milk can be determined by flavor, milk of varying fat percentages was standardized from skim milk and cream from the same source. The standardized samples were then judged as to preference by six persons, half of whom had had at least some experience in judging milk. A study of the results showed that it is impossible always to judge which of two samples of milk has the higher fat content by flavor. It is almost inconceivable that anyone would place a 2-percent milk above a 6-percent or 8-percent milk, but this was done at different times by inexperienced judges. This work brought out the fact that there is a wide variation in the ability of different individuals to detect fat in milk by the sense of taste.

Having shown that there is a wide range in the ability of individuals to place milk correctly according to fat content and that even experienced judges will sometimes place a 2-percent milk above a 4-percent milk, a 4-percent above a 6-percent, etc., the question arises as to what proportion of consumers can detect the difference between milk of a higher or lower fat content. Accordingly standardized samples of 3-percent and 5-percent milk, also samples of 3.5-percent and 5-percent milk, after shaking, were distributed to people in the habit of drinking milk but without experience in judging milk. The results indicate that while a surprisingly large percentage of consumers do not have the ability to detect a higher fat content in standardized milk without the aid of the cream line, the larger percentage prefer milk with the higher fat content.

It should be understood that these experiments dealt only with standardized samples prepared from the same source. There should be no attempt to apply these findings to normal milks of differing fat contents.

UTILIZATION OF MILK

Some investigation has been made as to the possibility of increasing the use of milk products in several ways, one of which is the preparation of a skim-milk powder with dried fruit flavor incorporated, which might be sold through the milk dealers or directly to the consumer for home manufacture.

HERD-IMPROVEMENT INVESTIGATIONS

J. C. McDowell, *in Charge*

On January 1, 1933, there were 881 dairy herd-improvement associations in active operation in 44 States. The number of cows on test in these associations was 358,501. This is a decline of about 12 percent in the number of associations and 16 percent in the number of cows on test as compared with the preceding year.

The individual records of approximately 292,413 cows in 791 of these associations were received and tabulated by the Bureau. Of these 292,413 cows, 186,683 were on test for 12 months. The records received from each association have been tabulated and summarized by herds, by associations, and by States, and the results, together with an analysis of each summary, have been furnished to the respective States from which the records were received. The State summaries showed the relation of milk and butterfat production per cow to income

over cost of feed and other factors; the comparative production of registered and grade cows by ages; and the relation of the cost of grain and of the season of freshening to other factors.

Production per cow throughout the United States has declined each year since 1929, according to the Bureau of Agricultural Economics, but there has been no decline in the dairy herd-improvement associations since the work began in 1906. In fact, in these associations butterfat production per cow has advanced more rapidly since 1929 than in the years immediately preceding, averaging 296 pounds per cow in 1929; 302 pounds in 1930; 306 pounds in 1931; and 310 pounds in 1932.

Study of the data seems to indicate that the increased production in recent years has been due probably to three causes: (1) The number of associations has declined each year since 1929 and the associations that dropped out had a lower average production than those that remained. (2) The herds that dropped out were lower-producing herds on an average than those that remained. (3) Individual herds that remained on test from year to year show an increased production. The improvement in these herds appears to have been brought about through closer culling, better feeding, and through the use of better bulls.

The work of the dairy herd-improvement associations brings about increased production per cow but does not result in overproduction because of the emphasis placed on culling. Economical production of milk and butterfat is the goal of this work, which is beneficial to producer and consumer alike.

Study of the 1932 records shows that 1 cow that produced 400 pounds of butterfat returned more income over cost of feed than 11 cows that produced 100 pounds of butterfat each; that on an average 1 cow that produced 10,000 pounds of milk brought in as much income over cost of feed as 10 cows that produced 2,000 pounds each; that the registered cows on test excelled the grade cows by 824 pounds of milk and by 25 pounds of butterfat per cow; that the cows that freshened in the fall excelled all others in production of milk and butterfat per cow; that cows that freshened in the winter were second; and that there was very little difference in yearly production between those that freshened in the spring and those that freshened in the summer.

In 1932, as in previous years, the records sorted and tabulated on the basis of cost of grain per cow showed that as the cost of grain per cow increased there was a fairly rapid and very constant increase in production of milk per cow, in production of butterfat per cow, and in income over cost of feed per cow. This, however, cannot all be attributed to the feeding of grain because it is a common practice in dairy herd-improvement associations to feed grain according to production. Therefore, the cows that were naturally the highest producers were fed the most grain.

For the testing year 1932 a special tabulation was made of the individual cow records of those herds that had an average butterfat production between 150 and 200 pounds of butterfat per cow. These herds were chosen to represent the average herds of the country and their average milk production was 4,483 pounds and their average butterfat production 190 pounds per cow, which is slightly above the average as reported for all cows by the Bureau of Agricultural Economics. This tabulation, it is believed, should give a fair idea of what would be shown if the records of all the cows in the United States could be tabulated. The study is not yet complete, but the table on culling shows that eliminating the lowest-producing 10 percent of the dairy cows would decrease production only 5 percent and that eliminating the lowest-producing 20 percent of the dairy cows would decrease production only 12 percent. Therefore, to do away with a 5-percent surplus in production it would be necessary to cull out 10 percent more cows than are now being culled and to eliminate a 12-percent surplus it would be necessary to cull out 20 percent more cows than are now being culled.

Culling out undesirable cows is a most important factor in herd improvement, and has been practiced by the members of dairy herd-improvement associations since such associations were first organized. Definite information, however, on the various reasons for the removal of cows from the herd has never been collected until recently. If the reasons for removal were definitely known, methods to prevent a large part of this heavy loss to the industry could doubtless be worked out. It is a short-sighted policy to raise dairy heifers to producing age and then find that they are low producers or for some other reason undesirable members of the herd.

Early last year the Bureau requested all States to furnish information on why cows were culled. Twenty States reported on more than 30,000 culls and gave the reasons for discarding them. There were five principal causes that were responsible for this vast wastage of cows: (1) Low production, (2) udder trouble, (3) sterility, (4) abortion, and (5) tuberculosis.

According to these figures, low production is the cause of 70.7 percent of the culling in our dairy herds. With better breeding a large part of this loss could be prevented. Of course, there will always be more or less culling where progress and improvement through breeding is being made. But the wastage of cows for this one reason alone is entirely too great. There is abundant evidence that the use of better herd sires would greatly reduce the number of low-producing cows in future herds.

Abortion, sterility, and udder trouble, all more or less related, account for only about 17 percent, and tuberculosis, which in past years was considered one of the worst plagues of dairy cattle, is now of minor importance.

For the first time in the study of the dairy herd-improvement association records it is now possible to make a comprehensive tabulation of the feed records. During the fiscal year 1932 the feed records of each individual cow, in all cases where the data seemed complete, were put into form for detailed study. These records have not yet been tabulated in any comprehensive way, but those so far studied show that the cows fed silage and legumes were the highest producers. The records seem to indicate that the feeding of legumes is much more important than the feeding of silage.

A forward step was taken a little over a year ago in connection with bull-proving work by substituting lactation records for 12-month records. During this year 2,149 pairs of lactation records of dams and daughters were received for study. From this number of comparisons 284 sires were proved. Of the 284 sires proved, 215 increased production and 69 decreased production. At the time of proving, 115 were reported living, 152 dead, and on 17 there was no report.

One hundred of these living proved sires had daughters that excelled their dams in average production of milk and butterfat, and 15 had daughters that produced less milk and butterfat than their dams.

During the calendar year 1932, 688 sires were proved with 12-month records, making a grand total of 2,671 sires proved to January 1, 1933. To date 15,596 sires are partly proved with one or more dam and daughter comparisons each. These records show the great possibilities of the proved-sire work.

On January 1, 1933, there were 342 active cooperative bull associations in 28 States. The 663 members of these associations owned cooperatively 1,498 pure-bred bulls which were bred to more than 57,000 cows. Thus far 209 bull-association bulls have been proved by the 12-month records of their daughters. The 1,771 daughters of these bulls on an average excelled the dams by 534 pounds, or 5.4 percent, in milk production, and by 29 pounds, or 7.4 percent, in butterfat production. This is a fairly good increase considering that the cows to which these sires were mated produced on an average 2,108 pounds of milk and 78 pounds of butterfat more than that produced by the average cow in dairy herd-improvement associations and about 5,620 pounds of milk and 212 pounds of butterfat more than that produced by the average cow in the United States.

DAIRY MANUFACTURING INVESTIGATIONS AND INTRODUCTION

R. W. Bell, *in Charge*

The work of the Division of Dairy Manufacturing Investigations and Introduction during the year has consisted of the following main projects: Creamery introduction, introduction of improved methods for making Swiss cheese, Cheddar-cheese introduction, improving the quality of casein, inspection of renovated-butter factories, supervision of the Grove City creamery, and other activities.

CREAMERY INTRODUCTION

The practice of grading cream and paying for it on a quality basis has been adopted in additional creameries in Tennessee this year, as a result of cooperative work by this division and the extension service of the university, and has been more closely adhered to by creameries already following that practice. Cream grading met with greater approval among producers this last year than ever before, but most farmers felt they were not financially able to improve their facilities for producing, cooling, and storing cream.

More than three fourths of the cream received by local creameries in Tennessee is graded and purchased on a basis of flavor and odor. Creameries not using this basis are to a great extent paying for cream on a basis of age, the classification being 2 days, 4 days, and more than 4 days old. Approximately 98 percent of all the cream purchased by creameries in the State was paid for in accordance with one of these methods of grading.

The Bureau's specialist in Tennessee acted in an advisory capacity in a project in which home-demonstration agents conducted demonstrations covering the production and care of milk and cream and the manufacture of butter, cheese, and cottage cheese on the farm. More than 10,000 women club members attended these meetings.

Several Tennessee creamery buttermakers exhibited samples of high-quality butter at butter-scoring contests. These samples do not represent the average quality of butter manufactured, but do show the skill of the buttermaker in selecting high-quality cream and his ability to make butter of fancy quality. At the Mid-South Fair at Memphis 11 entries from Tennessee received an average score of 92.07, while 29 entries from 10 other States received an average score of 89.94.

In the Tennessee master buttermaker's contest the maker whose butter receives the highest average score in 1 southern and 4 national contests is designated the master buttermaker for that year. The highest average score of the seven contestants this year was 93.3, and the lowest 92.38. As an indication of the excellent keeping properties of the butter, nine samples from Tennessee exhibited at Mason City, Iowa, scored an average of 92.46 when fresh and 92.48 after 3 months in cold storage.

A review of the creamery work in this State during the last few years reveals that material improvement has been made in the average quality of cream delivered to the creameries, the average quality of butter manufactured, and in the skill and efficiency of the creamery operators.

Five educational butter judgings were held in Alabama, in Arkansas, and in South Carolina. The samples of butter from the various creameries were scored for quality and composition, and a report was sent to each creamery immediately after each judging. The average number of samples submitted was greater than in any previous year. Material improvement has been made in all three States in maintaining a uniform color in the butter and in eliminating the body defect known as "leaky." Both these improvements indicate greater skill on the part of the buttermakers. Progress was made in controlling the composition of the butter, as evidenced by an increase in the percentage of samples that contained between 80 and 81 percent butterfat.

When this project was begun a few years ago there were two outstanding losses in the manufacture of butter in nearly all creameries—the loss of butter sticking to the churn, and the loss of salt in brine permitted to run from the churn while the butter was being worked. Both these losses have been almost wholly eliminated as a result of demonstrations and personal instruction at the various creameries. Since 6,500,000 pounds of butter were made in Alabama, Arkansas, and South Carolina in 1932, it is apparent that the elimination of these losses saved the creameries a large sum of money.

Assistance was given, as in other years, at the creamerymen's short course at the Alabama Polytechnic Institute. The influence of these short courses is reflected by the more skillful work done by the operators who attend them. The services available from the Bureau have helped to make creamerymen's short courses possible in several Southern States. Sixty-six men have registered for these courses in the last 4 years. Several have attended two and three times, evidence that they consider the benefits well worth the time and expense involved.

INTRODUCTION OF IMPROVED METHODS FOR MAKING SWISS CHEESE IN OHIO

The culture method of making Swiss cheese, developed and introduced by the Bureau, continues to gain favor in Ohio. Six new factories have adopted the method within the last year, making a total of 26 that now receive the pure cultures regularly from the Bureau.

The introduction of culture-cheese making has resulted in an increased return to the Ohio dairy industry of approximately $46,000 a year, since culture cheese regularly sells for around 2 cents a pound more than nonculture cheese and the annual production averages about 2,300,000 pounds.

Furthermore, in 1932 the factories made a higher percentage of high-grade culture cheese and a lower percentage of low-grade cheese than in the preceding year. This was the result of efforts to improve the quality of milk delivered by the farmers, as well as the use of improved methods in the factories. Sales records in these factories for 1931 and 1932 show that the improvement in quality resulted in a return of $12,525 more to the factories in 1932 than in the preceding year, making a total return of $58,525 more to the dairy industry of the State in

1932 than would have been returned if this cheese had not been made by the use of pure cultures and if the quality had not been improved. Since many of these factories are farmer-owned most of this increased return went directly to the farmer.

Some cheesemakers have had considerable trouble in keeping starters pure. Accordingly, a special effort was made to instruct them in the propagation of starters, at a special short course at the State university. In order that they may be more competent in their work and especially in the propagation and use of cultures, cheesemakers must have had 2 weeks' technical training before they can obtain the Bureau's culture service.

In the future the Bureau's introduction specialist will spend less time in the dissemination and examination of starters and more time on manufacturing problems. In order to lessen the task of supplying cultures and particularly the cultures of eye-forming bacteria, it is planned to distribute them in dry form when possible. The use of eye culture in dry form has proved satisfactory to date.

The use of information gained by following the acid-intensity (pH) changes in the cheese on the press, to determine the amounts of Bulgaricus and coccus starters to use in order to obtain the desired production of acid while the cheese is draining, is considered promising.

Further evidence has confirmed the importance of clarifying the milk in making Swiss cheese. The practice is now generally considered so essential that a number of nonculture factories have installed clarifiers.

The favorable returns received by producers who deliver milk to culture factories in Ohio have attracted many market-milk producers to the factories.

IN WISCONSIN

The Bureau's specialist, in cooperation with a State representative, carried on Swiss-cheese quality-improvement work throughout the calendar year. The plan followed in Wisconsin differs from the plan in Ohio, where an effort is made to work with all the culture factories. In Wisconsin a limited number of factories is selected for intensive work throughout the cheese season. Another group of factories is then selected for particular attention during the next cheese season. At most of these factories records of grades of cheese are kept from year to year, making it possible to determine progress in improving the quality.

In addition to working with the selected factories, the Bureau's specialist advised and assisted farmers and cheesemakers from about 150 factories regarding the quality of their milk, starters, and other matters pertaining to cheesemaking. Three thousand starters were examined and nearly a like number of samples of whey, and recommendations were made to meet each case. Meetings were held at 15 factories. This is one of the best ways to reach the farmers.

The microscopic appearance and acidity of the whey returned to farmers seems to be important in determining the kind of starters to use in the factory. If the whey is of high acidity and contains practically all rod-shaped lactic acid-producing bacteria, the specialist recommends a mixed starter with an acidity of 0.9 to 1.2 percent that is due to the presence of a large proportion of streptococcus organisms and relatively few rod-shaped lactic bacteria. At factories where low-acid whey, fermented chiefly by bacteria of the streptococcus type, is returned to farmers, cheesemakers obtain better results when they inoculate the kettle milk with a relatively large number of Bulgaricus organisms in proportion to the number of coccus organisms. The specialist examines the starters to establish the ratio of rod-shaped to coccus bacteria. If a mixture of about equal proportions is not being used to inoculate the kettle milk, steps are taken to bring this about as soon as possible.

The quality of the milk is of great importance in the manufacture of Swiss cheese. A certain amount of what is called kettle ripeness is desirable. The cheesemaker recognizes this ripeness in the way the curd works up in the kettle. A curd which shows advancement in the kettle is more likely to make good cheese than one which stays weak and soft, and especially so if the milk in the latter case shows bad curd in the fermentation test.

The methylene-blue and fermentation tests have been found to give the best index to the quality of milk desired for making Swiss cheese. Microscopic examination of the milk furnishes a means of locating sources of contamination on the farm.

The quality of the milk, the breed of cattle, and kind of starter play a large part in determining how much butterfat milk should contain for making Swiss cheese with the desired eyes, body, and texture. Standardization of the butterfat content of milk enables a maker to obtain a uniform fat content in the cheese but does not insure a uniform grade of cheese.

By comparing the grades of cheese made at the cooperating factories where intensive work was carried on in 1932 with those made at these same factories the preceding year, it was determined that over $25,000 more was received by the producers on account of the improvement in quality.

CHEDDAR-CHEESE INTRODUCTION

Requests for assistance pertaining to cheese work in general have increased, particularly in the last 2 years. The services of a specialist to demonstrate farm cheesemaking have been in particular demand. A leaflet containing directions for making cheese of the Cheddar type on the farm has been prepared for use by extension people and other demonstrators.

State extension men, cheese-factory managers, and cheesemakers with problems relating to establishing and managing cheese factories and quality improvement have been assisted in several Southern and Middle Western States. Some of the factories in these States, where dairying is a relatively new industry, have increased their volume of business rapidly. In one factory the amount of milk bought for processing in May 1931 was 1,500 pounds on each of 3 days in a week. There was a large supply of poor cheese on hand and the management planned to close the factory. The specialist made recommendations which largely remedied this particular situation, resulting from the manufacture of poor cheese. In May 1932 this factory was buying 10,000 pounds of milk daily and in May of this year the daily volume had increased to 19,000 pounds.

INSPECTION OF RENOVATED-BUTTER FACTORIES

Considerably more time than usual was spent on the regulatory work assigned to this Bureau. One factory discontinued the manufacture of renovated or process butter and two new factories were licensed.

Violations of the regulations pertaining to the marking and stamping of packages, the use of neutralizing agents in processing, the filing of incorrect returns, and the sale of process butter as undergrade creamery butter were encountered and reported to the Bureau of Internal Revenue. In a compromise settlement the company was fined $100. Alterations in this plant were necessary before it could comply with the sanitary regulations.

The common method of manufacturing process butter involves crystallization of the fat. However, a good grade of process butter is made by churning reconstituted cream, the fat of which was obtained from packing-stock butter. Further improvements may be accomplished whereby the resulting product will be materially better process butter.

At the request of the Bureau of Internal Revenue, a number of changes were suggested for incorporation in a proposed revision of Regulations No. 9, relating to taxes on margarine, adulterated butter, and process or renovated butter. Some of these proposed changes have been incorporated in the revised regulations, which will be issued over the signatures of the Secretary of the Treasury and the Secretary of Agriculture. The new regulations should strengthen the enforcement laws pertaining to adulterated and process butter.

The total amount of renovated butter made at the licensed plants during 1932 was 1,102,131 pounds, a decrease of 7,256 pounds from the preceding year.

EDITORIAL AND INFORMATION WORK

L. S. Richardson, *in Charge*

During the year 12 publications were printed and distributed, 10 of which were new and 2 were revisions of existing publications. At the end of the year five manuscripts were being prepared for publication. These publications and manuscripts represent the various research and service activities of the Bureau and are both scientific and popular in character. Twenty-six existing publications were also reprinted one or more times during the year.

Thirty-four articles by Bureau specialists were issued through scientific journals and dairy and agricultural publications, and five were prepared for the 1933 Yearbook of the Department. Nine press releases covering the news of the Bureau's work were issued through the Department Press Service, and assistance was given in the preparation and delivery of 51 broadcasts on dairy subjects through the Department Radio Service.

In cooperation with the Office of Motion Pictures a sound motion picture entitled "When the Cows Come Home" was completed early in the year. This picture is based on studies and records of dairy herd-improvement associations,

and demonstrates the economic benefits of building up a herd of high-producing dairy cows through culling and breeding. The picture has been extremely popular, four copies being in continuous use; three copies of a silent edition are available for use in districts having no facilities for using the sound edition.

Assistance was also given the Office of Exhibits in preparing subject matter for dairy exhibits at the Chicago Century of Progress Exposition and at various State and interstate fairs.

PUBLICATIONS

The following manuscripts written by members of the Bureau's staff for the purpose of disseminating information on the Bureau's work to the public were published during the year as Department publications or as articles in scientific journals or in the agricultural, dairy, or general press.

FEEDING AND NUTRITION

Apparent digestibility of, and nitrogen, calcium, and phosphorus balance of dairy heifers on, artificially dried pasture herbage. U.S. Dept. Agr. Jour. Agr. Research 45 : 557–563.

Better feed crops and pastures needed to cut dairy production costs. U.S. Dept. Agr. Yearbook 1933 : 284–287.

The calcifying properties of green, artificially dried, and sun-cured pasture herbage. Abstr. Papers, Ann. Meeting Amer. Dairy Sci. Assoc. 1933 : 61.

Effect of tryptophane on gain in weight when used to supplement corn-meal protein. (Abstract.) Jour. Biol. Chem. 97 (1) : 32–33.

Sudan grass as hay, silage, and pasture for dairy cattle. U.S. Dept. Agr. Tech. Bul. 352.

The vitamin A and the vitamin E content of field-cured and artificially cured alfalfa hay. Nebr. Agr. Expt. Sta. Research Bul. 62. (In cooperation with the U.S. Dept. Agr. Bur. Dairy Indus.)

BREEDS AND BREEDING

Analysis of the advanced registry records of 611 daughters of 51 Ayrshire sires. U.S. Dept. Agr. Tech. Bul. 349.

Breeding better dairy cattle facilitated by studies in genetics. U.S. Dept. Agr. Yearbook 1933 : 280–284.

Breeding history and gross changes found on autopsy in the genital organs of dairy cattle. Jour. Amer. Vet. Med. Assoc. 81 : 408–410.

Developments in breeding dairy cattle. (Extracts of address.) Hoard's Dairyman 77 : 479, 493.

Proved sire classifications. A constructive criticism of the proved sire program adopted by the American Jersey Cattle Club at its annual meeting. Hoard's Dairyman 77 : 431, 443–444.

Reproduction and health records of the Beltsville herd of the Bureau of Dairy Industry. U.S. Dept. Agr. Tech. Bul. 321.

Some results of inbreeding grade Guernsey and grade Holstein-Friesian cattle. U.S. Dept. Agr. Tech. Bul. 339.

A study of age-correction factors. A report to the production section of the American Dairy Science. Association. U.S. Dept. Agr. Bur. Dairy Indus. (Mimeographed, unnumbered.)

The successful selection of proved sires. Hoard's Dairyman 77 : 451, 465.

PHYSIOLOGY OF MILK SECRETION AND MILK PRODUCTION

Comparison of conformation, anatomy, and skeletal structure of the cow and bull of a dairy breed. U.S. Dept. Agr. Jour. Agr. Research 45 : 641–674.

Composition of milk obtained from amputated cow udders. U.S. Dept. Agr. Jour. Agr. Research 45 : 401–419.

Diabetogenic principle of the anterior pituitary. Soc. Expt. Biol. Med. Proc. 30 : 1370–1371.

Initiation of copious milk secretion in virgin goats by anterior pituitary. Soc. Expt. Biol. Med. Proc. 30 : 1372–1373.

Quality, size, capacity, gross anatomy, and histology of cow udders in relation to milk production. U.S. Dept. Agr. Jour. Agr. Research 45 : 577–607.

Quantity of milk obtained from amputated cow udders. U.S. Dept. Agr. Jour. Agr. Research 45 : 385–400.

Recent advances in the physiology of sex. Med. Ann. D.C. 1 : 217–221.

Variations recorded in the study of the conformation and anatomy of 318 dairy cows having records of production. (A preliminary report.) U.S. Dept. Agr. Bur. Dairy Indus. BDIM-589. (Mimeographed.)

HERD MANAGEMENT AND IMPROVEMENT

Records that show each cow's output are basis of successful dairying. U.S. Dept. Agr. Yearbook 1933 : 287–290.

MILK AND CREAM

Effect of certain factors on amount of fat consumed in milk served to school children. Internatl. Assoc. Dairy and Milk Insp. Ann. Rpt. 1932 : 197–201.

Quality of dairy products depends on numerous factors other than the butterfat. U.S. Dept. Agr. Yearbook 1933 : 290–295.

Light a factor in rancidity. (A preliminary report.) Science 76 : 295.

Photochemical oxidation of cottonseed oil. Indus. Engin. Chem. 25 : 167–168.

The precipitation of milk proteins by means of trichloroacetic acid. Jour. Assoc. Off. Agr. Chem. 16 : 140–146.

The distinguishing characteristics of Lactobacillus acidophilus. Jour. Bact. 25 : 595–621.

CHEESE

The practical control of quality and uniformity of cottage cheese. Internatl. Assoc. Milk Dealers, Plant Sec. Proc. Ann. Conv. 1932 : 27–34.

The standardization of cottage cheese. Amer. Creamery and Poultry Prod. Rev. 75 : 52, 54, 56.

ICE CREAM

Ice-cream formulas. U.S. Dept. Agr. Bur. Dairy Indus. (Mimeographed, unnumbered.)

The incorporation of air during the homogenization of cream and of ice-cream mixes. Jour. Dairy Sci. 15:367–370.

The manufacture of low-lactose skim milk for use in ice cream. U.S. Dept. Agr. Bur. Dairy Indus. (Mimeographed, unnumbered.)

BYPRODUCTS

Problem of finding uses for byproducts of dairy industry partly solved. U.S. Dept. Agr. Yearbook 1933:299–302.

Effect of calcium and phosphorus on adhesive strength of paper-coating casein. Indus. Engin. Chem. 24:791–793.

Effect of excessive temperatures and time of drying on solubility of casein. Indus. Engin. Chem. 24:1081–1082.

Making casein for uniformity and quality. Natl. Butter and Cheese Jour. 23 (26):10, 32-34.
Optical activity of commercial caseins. Indus. Engin. Chem. 24:1077–1079.
Report of conference on paper-coating casein, Washington, D.C., Jan. 13, 1933. U.S. Dept. Agr. Bur. Dairy Indus. (Mimeographed, unnumbered.)
The heat coagulation of milk. I. Variations in the compositions, heat stability, and other tests of milks from four cows during the course of a lactation period. Jour. Dairy Sci. 15:331–343.
The heat coagulation of milk. II. The influence of various added salts upon the heat stabilities of milks of different concentrations. Jour. Dairy Sci. 15:345–366.

MILK PLANTS

Operation and management of milk plants. U.S. Dept. Agr. Circ. 260.

MISCELLANEOUS

A balanced dairy extension program. Abstr. Papers Ann. Meeting Amer. Dairy Sci. Assoc 1933:10–11.
The coronation of Regina II. Guernsey Breed. Jour. 43:115, 136.
The dairy industry. Amer. Yearbook 1933:414–416.
An extension and a limitation of the thiocyanate method for the preparation of 2-thiohydantoins. Jour. Biol. Chem. 99:429–433.
The preparation of esters of α, á-bis-acetylaminopropionic acid. Jour. Biol. Chem. 100:287–289.
The preparation of optically active thiohydantoins and the racemization of amino acids as their azlactones. Jour. Biol. Chem. 99:213–216.
Report of the chief of the Bureau of Dairy Industry for the fiscal year ended June 30, 1932.
Report on the hydrogen-ion concentration of flour and baked products. Jour. Assoc. Off. Agr. Chem. 15:570–572.
Variation in the weight of a given volume of different flours. II. The result of the use of different wheats. Cereal Chem. 9:531–534.
Variation in the weight of a given volume of different flours. III. Causes for variation, milling, blending, handling, and time of storage. Cereal Chem. 9:628–636.

U. S. GOVERNMENT PRINTING OFFICE: 1933

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REPORT OF THE CHIEF OF THE BUREAU OF ENTOMOLOGY, 1933

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY,
Washington, D.C., September 23, 1933.

SIR: I submit herewith a report of the work of the Bureau of Entomology for the fiscal year ended June 30, 1933.

Respectfully,

C. L. MARLATT, *Chief.*

Hon. HENRY A. WALLACE,
Secretary of Agriculture.

GENERAL

APPROPRIATIONS AND EXPENDITURES

The appropriation made to the Bureau for the fiscal year 1933 was $2,471,700. In addition to this, $55,000 was reappropriated from the unexpended balance of the appropriation made in 1931 for work on the Mediterranean fruit fly, bringing the total available to $2,526,700. This amount is $392,040 less than that available for the fiscal year 1932. Approximately one half of this difference represents reductions applied uniformly through the service in accordance with the Economy Act. Changes in the allotments for certain lines of work account for the remainder. Included in the latter are reductions made following recommendations from the Bureau that certain activities, such as the large-scale bait-trapping work on the oriental fruit moth, investigations on the blueberry maggot in Maine, and control of the Mormon cricket in Colorado, be discontinued. Small reductions in the allotments for work on the Japanese beetle and the European corn borer also contribute to the total. A large part of the reduction ($155,395) was made when the appropriation bill was considered by the Senate and applied to the following three appropriation items: Fruit and shade tree insects, $47,645; cotton insects, $72,820; and taxonomy and interrelations of insects, $34,930. The appropriation for the fiscal year 1933 did not provide funds with which to initiate new investigations or enlarge those under way.

Complying with the general administrative program, an effort was made throughout the year so to direct the work as to effect such additional economies in expenditures as could be made without seriously interfering with essential work under way. This policy and the cooperative effort of the Bureau employees effected savings in available funds totaling $417,200, or approximately 16 percent.

CHANGES IN PERSONNEL

On February 13, 1933, D. L. Van Dine was appointed chief of the Division of Fruit and Shade Tree Insects, filling the position made vacant December 31, 1931, by the resignation of A. L. Quaintance. Mr. Van Dine's wide experience in economic entomology over a period of 31 years was fully set forth in Department publications at the time of his appointment. This experience has covered experiment station work in Hawaii, Puerto Rico, and Cuba and research work in connection with this Bureau in various fields as well as valuable experience in the World War in charge of insect sanitation.

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POSSIBILITY OF FULL-SEASON RECORDS

The results of much of the experimental work of the Bureau dealing with the pests of crops maturing in the late summer and fall can be determined with accuracy only after the crop has ripened and usually in connection with its harvesting. This applies particularly to plat and field tests concerning such major pests as the European corn borer, bollweevil, and codling moth, and also the general subject of poisonous residues applying to many fruit and vegetable crops. Similarly, the important phase of carry-over and outlook for the next season as to these and other pests can be determined only late in the season. It follows that reports of most crop pests prepared in August or even in early September must be based, in large part, on the final records of crops and conditions of the previous season. With the object of making future reports reflect more accurately the results of the current season, the idea has been presented, with favorable reception, to the Director of Information that steps be taken to secure legislation permitting the deferment of such reports to the end of October. This report summarizes the results of work up to the middle of September.

CLIMATIC CONTROL

The importance of climatic control, as related to a number of the major insect pests, was emphasized during the year. Such control has resulted from low winter temperatures and from conditions unfavorable to insects during spring and summer, involving heat and cold, moisture and drought. These experiences indicate that climatic factors may be vastly more important than natural controls through parasites, or control by artificial means. The notable examples of such climatic action during the past year are itemized below:

Prolonged periods of intense cold, involving temperatures of —20° to —50° F., led to a destruction in Oregon, Washington, northern California, and in the forests of the northern Rocky Mountains of from 25 to 92 percent of the overwintering broods of bark beetles. This destruction has made it possible to abandon various control projects that had been planned and to discontinue others that were under way, and is undoubtedly a type of control which, in past ages, has been one of the principal factors in maintaining a balance between forest growth and insect pests.

The European corn borer made a notable increase in the western area during the season of 1932, with corresponding heavy population of larvae entering hibernation and successfully overwintering. This fully justified the prediction last spring of a great increase in borers and damage for the season of 1933. Throughout this western area, however, the late spring and early summer conditions of rain and cold were thoroughly unfavorable to the early planting of corn, with result that when the moths emerged, as they did in great numbers, the corn was too small to be attractive and such egg laying as later took place came at a period of unusually hot, dry weather, resulting in the destruction of many of the egg masses. While it is still too early to get the exact records, the present indications point to no increase of this pest.

The Hessian fly, from fall and winter conditions, threatened unusual damage in wheat-growing areas east of the Rocky Mountains and warnings to that effect were distributed. The drought and heat of the early summer, however, gave this pest such an effective setback as to eliminate injury to the crop and also any danger of a general outbreak thereof in the near future.

In the case of the pea weevil in the very important Palouse area of Washington and Idaho, the low temperatures of the winter of 1932–33 caused such high mortality among hibernating weevils as to leave the crop of 1933 relatively free from damage.

At the opening of the season the bollweevil threatened very heavy crop damage on the basis of the unusually large number of weevils entering hibernation and the very considerable weevil survival into the spring of 1933. The excessive drought and heat in June and July over much of the Cotton Belt greatly checked weevil development, with result that only spotted weevil infestation has been experienced.

The reverse of the above is presented by the chinch bug. That this native pest is particularly favored by drought conditions has long been known, and this was demonstrated this year by its notable increase along with the drought in Iowa, Kansas, Missouri, and Indiana, together with unusual instances of injury in the eastern area—Pennsylvania, New York, and Vermont.

EXCHANGE OF USEFUL INSECTS

Note should have been made in last year's report of the assignment of Curtis P. Clausen to the duty of aiding the Chief of Bureau in coordinating the work of the Bureau and of the several States in the importation and distribution of beneficial insects. In this position he is responsible directly to the Chief of Bureau and will aid the Chief in the administration, in cooperation with the Bureau of Plant Quarantine, of the Insect Pest Act of 1905. Mr. Clausen's wide knowledge of parasitic and other beneficial insects, and especially his own extended and varied participation in and direction of their importation and colonization, well qualify him to fill this position. In the fall of 1932 the field station in Japan was made headquarters for all the Bureau's activities in the Orient on parasitic and predacious insects, and the direction from Washington of this field work was assigned to Mr. Clausen.

Under this arrangement the various divisional laboratories will continue to receive, study, and colonize in this country natural enemies which may be imported to aid in controlling various introduced pests. Information as to such importations and colonizations will be found in the reports of the several divisions.

In response to requests, parasites of important crop pests were sent to 3 dominions and 1 colony of the British Empire and to 6 other foreign countries during the year. Shipments of the egg parasite *Trichogramma minutum* Riley were made to Canada and Germany. Two parasites of the oriental fruit moth, *Dioctes molestae* Uch. and *Trichogramma euproctidis* Gir., were sent to Argentina. *Glypta rufiscutellaris* Cress. and *Pristomerus ocellatus* Cush., two American parasites of the oriental fruit moth, were forwarded to Japan. *Macrocentrus ancylivorus* Rohwer, the most useful American parasite of the oriental fruit moth, was sent to Italy. Parasites of the Mediterranean fruit fly were sent to Australia, the consignments including representatives of four important species—*Diachasma fullawayi* Silv., *D. tryoni* Cam., *Opius humilis* Silv., and *Tetrastichus giffardianus* Silv. Two of the opiine fruit-fly parasites, *Diachasma tryoni* Cam. and *O. humilis*, well established in Hawaii, were sent to Spain. A consignment of *Phanerotoma tibialis* Hald., an important parasite of the codling moth, was sent to New Zealand. *Aphelinus mali* Hald., a parasite of the woolly apple aphid, was sent to Ecuador and a shipment of *Compsilura concinnata* Meig. was sent to Barbados.

Adults of three of the Mediterranean fruit fly parasites, *Diachasma tryoni*, *Opius humilis*, and *Tetrastichus giffardianus*, were sent to California for possible use on the walnut fly, *Rhagoletis completa* Cress.

FRUIT AND SHADE TREE INSECTS

Mention was made earlier in this report of the appointment of D. L. Van Dine as Chief of this Division, effective February 13, 1933.

APPLE INSECTS

CODLING MOTH

Infestation by the codling moth in many eastern and middle-western areas during 1933 has been the most severe that has been reported in the past 10 years. In the Pacific Northwest the infestation has been nearly as serious as in 1932. Contributing factors have been uncertainty as to the spray program and the abandonment of an increasing number of orchards. If the season had not been unusually late, the situation would have been even more serious.

The codling-moth problem has assumed an even greater importance than hitherto, owing to the increasing appreciation of the potential danger to human health of the presence of even minute quantities of lead as well as arsenic on food products.

The ratio of lead to arsenic trioxide in commercial lead arsenate is very close to 2 to 1. It appears that the arsenic often weathers off more rapidly than does the lead, and in some cases the quantity of the latter present at harvest time has been three or four times that of arsenic. Also, certain of the common alkaline washing solutions fail to remove the lead, although these have been effective in the removal of arsenic from apples under the conditions of increased adherence resulting from spraying with lead arsenate in combination with oil emulsions, or from apples which have developed excessive quantities of wax.

The lead tolerance established by the Department (announced April 2 as 0.014 grain of lead (Pb) per pound of fruit, increased June 20 to 0.02 grain of lead (Pb) per pound) has necessitated modifications of the Bureau's former recommendations for codling-moth control. Statements have been sent to State and experiment station entomologists, outlining the situation and giving them all available information as to other materials which might be used, particularly in the later part of the spray schedule. Unfortunately, fully satisfactory substitutes for lead arsenate are not yet available and in many sections of the country it is extremely difficult to control the insect and yet meet the requirements as to residue.

In the Pacific Northwest a combination of oil with nicotine sulphate appears to be fully as effective as lead arsenate in the later applications, although the greater cost of this mixture has had a tendency to restrict its use. After the announcement of a fluorine tolerance on June 20, certain fluorine compounds, particularly cryolite, have been recommended for the Pacific Northwest, where they have been found effective in codling-moth control. Excessive residues from sprays of these materials must, of course, be removed. Certain nonlead arsenicals, particularly calcium arsenate, have been suggested as possible substitutes, although they are less effective than lead arsenate and more likely to injure foliage. Greater emphasis has been placed on certain control measures hitherto considered supplementary in nature. These include banding, especially the use of chemically treated bands, and general orchard and packing-shed sanitation.

The ultimate solution of this problem is elimination of lead arsenate from the greater part of the spray schedule. The task of discovering or developing adequate substitutes for lead arsenate is being carried on by the Bureau of Entomology in cooperation with other bureaus of the Department, as well as with many of the State experiment stations. Although the substitute materials already mentioned are useful under certain conditions, the finding of a generally practical substitute for lead arsenate is proving a difficult task.

Because of the position taken by the Department in the spring of 1933 regarding residues of fluorine, no experiments were planned with the fluorine compounds, with the exception of certain small plots included in the Yakima, Wash., outline, to provide material for experiments in the removal of fluorine residues. In these field plots cryolite has appeared to be the equal of lead arsenate in codling-moth control. With the announcement of a fluorine tolerance, field experiments against the second brood were undertaken at Vincennes, Ind., with barium fluosilicate and cryolite, in combination with summer oils. Preliminary reports indicate that these materials are giving a fair degree of control, although cryolite has caused serious injury to fruit of the Golden Delicious variety.

Nicotine sulphate with oil emulsion, following early season applications of lead arsenate, has given effective control in the Pacific Northwest, and reasonably good results in Arkansas and Indiana.

Nicotine tannate, which has shown a great deal of promise in experiments conducted by the New Jersey Agricultural Experiment Station, has caused more or less injury to fruit and foliage in 2 of the 3 experiments conducted by the Bureau, and has not been found particularly effective in codling-moth control. The injury may have resulted from the combination of some ingredient of the nicotine tannate with arsenic which persisted on the trees from previous applications of lead arsenate or calcium arsenate.

The chemically treated bands developed several years ago by workers of the Bureau of Entomology are rapidly coming into commercial use, and appear to be of considerable value in reducing infestations, thus improving the control obtained, or reducing the amount of spraying that is necessary, and lessening the residue load at harvest time. The experiments the past season have shown that a 2-inch band captures nearly as many worms as a band 4 inches in width. Improvements have been made in the methods of treating bands, and a great many growers have prepared their own. The bands placed on the market by manufacturers have shown a steady improvement. Further attention is being given to the possible use of bait traps in controlling the codling moth. These capture large numbers of moths, but thus far their use has been chiefly as indicators of the periods during which the moths were active, as a guide to the timing of spray applications. The possibilities for their use in direct control are now being explored further.

In cooperation with the Georgia State entomologist's office, experiments are being conducted at Cornelia, Ga., with the utilization of the egg parasite

Trichogramma minutum Riley. The results of these experiments will be reported at a later date.

THE TARNISHED PLANT BUG

Further attempts to control the tarnished plant bug in orchards by means of insecticides have given discouraging results, and a careful study is now being made of host-plant relations. This insect breeds and feeds during most of the year on cover crops or weeds in and close to the orchard, and its attack on the fruit is restricted to a brief period in early spring. It is hoped that some adjustment of cover-crop practice may be worked out which will minimize injury by this insect.

OTHER APPLE INSECTS

Work on the relation of insects to the perennial-canker disease of apple has been continued at the Wenatchee (Wash.) laboratory. At the close of the period of canker extension in early June 1933 it was evident that there was a rather general extension of individual cankers.

In all cases where cankers had been cleaned out and the woolly apple aphid excluded thereafter, perfectly healthy calluses were invariably found. Where the woolly aphids had gained entrance to the cankers, however, there was in all cases a great amount of extension. A similar association of the "die-back" of the calluses with previous injury by woolly aphids has been indicated by numerous records of unprotected calluses kept under frequent observation. The woolly apple aphid is therefore an important factor, and may even be exclusively responsible for the extension of the perennial cankers. The elimination of this insect therefore appears to be important in controlling the disease. This has been found possible by the use of a number of canker paints consisting of nicotine sulphate with 7 to 20 percent of nondrying or slowly drying oils, such as castor oil, sperm oil, or cottonseed oil.

The aphid parasite *Aphelinus mali* Hald., which was introduced into the Wenatchee district 2 years ago, is now well established in the orchard in which the liberations were made and in nearby properties. The parasite is expected to become an important factor in keeping the woolly-aphid population within bounds.

PEACH INSECTS

PLUM CURCULIO

The plum curculio continues to be a major peach problem and is under investigation by the laboratories at Fort Valley, Ga., and Harriman, Tenn. The Georgia peach crop was unusually free from injury by the plum curculio during the 1933 season. There was a light carry-over from the previous season. The emergence of adult first-generation curculios, which produce the second brood of larvae in the fruit at harvest time, was delayed several weeks by dry weather during the period when the insect was in the ground. The crop thus escaped serious injury.

Although the residues of arsenic on peaches have rarely been found in excess of the tolerance of 0.01 grain of arsenic trioxide per pound, there appeared some danger that the lead residues in areas in which applications are necessary for second-brood curculio might in some cases be greater than the tolerance as first announced of 0.014 grain of metallic lead per pound. The Bureau, therefore, issued to State and experiment station entomologists a revision of its spraying recommendation for southern peach orchards, changing the last lead-arsenate application from 4 weeks to 6 weeks before harvest, and emphasizing the importance of supplementary control measures, such as jarring, cultivation, and the destruction of infested dropped fruit. The analyses of peaches sprayed in accordance with various schedules in 1933 indicate that the regular schedule followed in areas in which two broods occur, which calls for an application of lead arsenate 4 weeks before harvest time, carries the residue of lead approximately to the 0.014 grain per pound tolerance indicated for the next growing season; in exceptional cases the residue was somewhat in excess of this figure. It is believed that by a slight modification of the spray program, the avoidance of excessively heavy spraying, and a greater emphasis on the supplementary measures just mentioned, the residue problem on southern peaches may be handled without serious difficulty. The spray

schedule recommended for northern peach orchards appears to be unobjectionable from a residue standpoint.

Experiments to determine the effectiveness of schedules in which the dates of the final application of lead arsenate were varied from 4 to 7 weeks before harvest were conducted at Fort Valley. Because of the lightness of the infestaton, the results were inconclusive, and further experiments are needed in order to determine both the relative effectiveness of various schedules and the quantity of lead residue resulting from them under a range of climatic conditions.

Because of the position taken by the Department in early spring regarding residues of fluorine, the experimental work with fluorine compounds for the control of the plum curculio was somewhat curtailed, although a number of plots were included in the experiments at Harriman, Tenn. The results of these experiments on curculio control have not yet been reported. The residue analyses suggest that either cryolite or barium fluosilicate may be substituted for lead arsenate in all regular applications without causing residues of fluorine in excess of the 1933 tolerance.

ORIENTAL FRUIT MOTH

The work with parasites of the oriental fruit moth has been continued along the lines discussed in earlier reports. During the season of 1932 the collecting and rearing of *Macrocentrus ancylivorus* Rohwer was continued on a slightly reduced scale, in cooperation with a number of State and local organizations. A total of nearly 40,000 adults of this species were reared, and these were liberated in 132 colonies in 15 different States. This species has now been introduced into the most important peach-growing districts in which the fruit moth is a factor. Although there are a number of localities in which liberations are yet desirable, the work with *Macrocentrus* has for the most part been suspended, as a part of the necessary economy program.

Mention was made in last year's report of the transfer of the search for foreign fruit-moth parasites to Japan, where the parasite species were found to be rather numerous and effective. During the latter part of the season of 1932 several sendings were made, and shipments have continued in increasing volume during the season of 1933. Unless known to be entirely primary in habit, each parasite species is received and handled under close observation until experience with it has demonstrated that it can safely be released in orchards. Among the species received and liberated thus far may be mentioned the following: *Cremastus flavoorbitalis* Cam., *Orgilus*, n. sp., *Bassus* sp.. *Apanteles* sp., *Elodia flavipalpis* Ald., *Dioctes molestae* Uch., *Phanerotoma grapholithae* Mues., *Macrocentrus thoracicus* Nees, and *Pristomerus vulnerator* Panz.

In addition, several fruit-moth parasites were obtained during 1932 in Australia by an investigator who was sent there primarily for the purpose of obtaining parasites which might be useful in the control of the Japanese and Asiatic beetles. One of these proved to be in part secondary in its habits and was not liberated, but two of them, namely, *Gambrus stokesii* Cwfd. and *Perisierola angulata* Mues., have been released.

Investigations of bait traps for the control of the oriental fruit moth have been continued at Cornelia, Ga. In spite of the lightness of the infestation during the season of 1933, significant information has been obtained. The outstanding bait during the season has been terpenyl acetate, ½ c c per quart in a 10 percent solution of medium-soft brown sugar. This was one of the four baits giving the best results during the 1932 season. Although the large-scale bait-trap experiments have been discontinued, one small, partially isolated orchard was baited during the 1933 season until harvest time. The degree of infestation was determined in this orchard and in two others used primarily for comparisons of various bait materials, as well as in a number of comparable unbaited orchards. The reduction in injury appeared to be 47 percent in one orchard, 77 percent in a second, and 78 percent in a third. This indicates that a considerable degree of control of the fruit moth is possible by baiting comparatively small areas. Because of the extensive inter-orchard movement of the moths the benefits from small-scale baiting are not cumulative from year to year. Continuance of the baits after harvest is considered practical only where large areas are baited. As practiced in one of the orchards baited in 1933, baiting should cost not more than $3.50 per acre.

A special study has been made of the influence of weather conditions on the behavior of the moths. When temperatures are favorable—above 60° to

65° F.—light intensity appears to be the most important factor regulating moth behavior. The moths seem to be the most active when the light intensity is less than 0.5 foot candle. Complete darkness, however, as well as light intensity of more than 30 foot candles, will practically stop their activity.

Limited field experiments with insecticides for the fruit moth were conducted at Vincennes, Ind., in 1932. The results of these experiments indicate a partial reduction in the fruit-moth infestation from the use of barium fluosilicate, cryolite, nicotine tannate, and nicotine sulphate, each used with 1 percent of a white-oil emulsion. These reductions, however, were not sufficient to constitute commercial control, and severe injury developed in the plats sprayed with the fluorine compounds in combination with the oils.

OTHER PEACH INSECTS

Because of the suspicion that has been directed toward the peach borer as a possible agent in the transmission of the phony peach disease, greater attention is being given to the biology and control of this insect. Detailed life-history studies on which orchard control is based are practically completed and will be summarized for publication in the near future. Further biological work on the feeding habits of the larva and the adult habits of oviposition and flight are indicated in connection with the possible relation between the peach borer and the phony peach disease. Emulsions of cottonseed oil carrying paradichlorobenzene in solution have continued to give good results in the control of the peach borer on trees of all ages, without causing appreciable injury. It is hoped that it may be possible to extend the use of this treatment to peach nursery stock. The chief problem in using the para-oil emulsion has been the regulation of the quantity applied to each tree. The Fort Valley laboratory has developed a very satisfactory device for this purpose.

Further work is being done in the control of the San Jose scale. Certain lubricating oils having viscosities within the usual range, but having a high volatility, have been found less effective in scale control. Lime-sulphur in the last 2 or 3 years has been found to have a rather low degree of efficiency in the control of the San Jose scale in southern peach orchards, and the oils are being given preference in recommendations for that region.

NUT INSECTS

Because of the reduction in appropriations, it has been found necessary to curtail very materially the work undertaken on nut insects. The chestnut-weevil investigations are being practically discontinued, although a limited number of observations will be made by the personnel of the Takoma Park, Md., laboratory. Pending a determination as to the future of the work under this allotment, the activities at the Shreveport, La., station, dealing chiefly with the pecan phylloxera and the obscure scale, have been suspended for the time being.

THE PECAN NUT CASE BEARER

The results previously reported in the control of the pecan nut case bearer by the use of nicotine sulphate have been fully corroborated by further experiments conducted during the early part of the season of 1933. The percentage control resulting from the use of nicotine sulphate (40-percent nicotine) 1:1,000 in various combinations was as follows: With bordeaux mixture 3:4:50, 19 percent; with 3 different white-oil emulsions, each at a strength of three fourths of 1 percent, 91, 92, and 94 percent, respectively; with fish oil one fourth of 1 percent, 90 percent. The white-oil emulsions were much less effective when used alone. These treatments are somewhat expensive, but with an improvement in economic conditions they may well prove practical for growers who are suffering severe losses from the nut case bearer.

At the Brownwood, Tex., laboratory 3 field experiments in the season of 1933 with lead arsenate, 3 pounds to 50 gallons, gave reductions in nut-case-bearer infestation of 82, 96, and 96 percent, respectively. These applications, made under the semiarid conditions of central Texas, caused no foliage injury. The good results obtained are in contrast to the failure of lead arsenate to give satisfactory control under conditions that exist in southern Georgia. Further confirmation of these results, both as to control and foliage injury, is needed before recommendations can be made to the pecan growers of Texas.

Experiments have been conducted with the egg parasite *Trichogramma minutum* for the control of the nut case bearer as well as of certain other pecan insects. With marked improvements in the rearing technic, it has been possible to increase enormously the number of parasites reared and to reduce the cost per unit. Liberations of large numbers of the *Trichogramma* at the proper time in several pecan orchards infested by the pecan nut case bearer, however, have not resulted in any apparent reduction in the infestation. It has been found that several strains of *Trichogramma* exist, which vary greatly in their behavior. Most of the work with pecan insects has been done with certain of the darker strains. It seems desirable in further experiments to determine the possibility of utilizing one or more of the yellow varieties.

BLACK PECAN APHID

The black pecan aphid (*Melanocallis caryaefoliae* Davis) appears to be of increasing importance in the southeastern pecan-producing areas. It seems to be especially abundant in orchards which have been sprayed with bordeaux mixture. For instance, recent counts showed the infestation on bordeaux-sprayed trees to be 10 times as great as that existing on similar trees not sprayed with bordeaux. The reason for this difference has not yet been determined.

This aphid causes a premature defoliation, which, if extensive, has a serious effect on the crop of the following season. Records taken in the spring of 1933 showed that on trees in which the aphids had been controlled by spraying, 23 percent of the shoots produced blossoms, as compared with less than 2 percent in unsprayed trees which had been defoliated by the aphid.

Extensive experiments have shown that, when combined with standard-strength bordeaux mixture, nicotine sulphate (40-percent nicotine) as dilute as 1 part in 4,000 will give practically complete control of the pest. Kills ranging from 96.6 to 99 percent have resulted from the use of nicotine sulphate 1:4,000 with white-oil emulsions at strengths of one half of 1 percent to 1½ percent. Different soaps varied in their value for use with nicotine sulphate and were on the whole less satisfactory than bordeaux mixture.

OTHER PECAN INSECTS

Under conditions of very light infestation, last season's results in the control of the pecan phylloxera (*Phylloxera devastatrix* Pergande) have been duplicated. Good control has been obtained with nicotine sulphate, applied either in the late-dormant or delayed-dormant period. The best results were obtained with nicotine sulphate (40-percent nicotine) 1:800 with lime-sulphur at various strengths. Nicotine sulphate with soap, and with oil emulsions from 1 to 4 percent in strength, was nearly as effective.

The investigations of the obscure scale have been practically completed, and reports on the studies are being prepared for publication. The susceptibility of the pecan tree to injury by oil sprays limits the strength of oil that can be used. Fortunately, however, the obscure scale has only one generation a year and multiplies much less rapidly than many other species of scale insects, such as the San Jose scale. Four percent of oil in the form of lubricating-oil emulsion appears to be reasonably safe, and an application at this strength will satisfactorily hold a scale infestation in check, although complete kill cannot be obtained. If the trees are in a vigorous, active growing condition, strengths of oil as high as 6 percent may be used with a fair degree of safety and a considerably more complete kill of the scale. Considerable injury has been caused to recently topworked pecan trees the last few years by the insect known as the American plum borer (*Euzophera semifuneralis* Walk.). The larvae tunnel around the sprouts near the point of junction with the tree, weakening the sprouts and causing them to be readily blown off by the wind. Experiments conducted at the Brownwood, Tex., laboratory in March 1933 showed that this insect may be fairly well controlled by painting the injured areas with a mixture of 1 pound of paradichlorobenzene in 2 quarts of cottonseed oil, as used for the lesser peach borer. No injury resulted from the treatment.

The representatives of the Bureau of Entomology at Albany, Ga., are cooperating with those of the Bureaus of Agricultural Engineering and Plant Industry in studies of spraying and dusting machinery and accessories for use in applying insecticides and fungicides to pecan trees.

Experiments are under way with the control of the pecan weevil by the use of carbon disulphide emulsion and other soil fumigants against the larvae or pupae in the soil. If effective treatments of this nature can be worked out, they would be useful chiefly in dealing with portions of orchards most heavily infested. This species is often concentrated chiefly in a limited number of trees in a given orchard. Three years of work have shown that the hydrated-lime spray, although partially effective as a repellent against the adult weevil, is not a practical control method against severe infestations.

GRAPE INSECTS

The already serious spray-residue problem on grapes was greatly intensified by the action relating to residues of lead. In order to give to the entomologists of the experiment stations of the various States full information on the subject, a statement was sent to them in the late winter. In addition to outlining the situation, recommendation was made that in the post-blossom application for the grape-berry moth the lead arsenate formerly recommended be replaced by calcium arsenate, which in grape-spraying experiments over a period of more than 10 years in the Lake Erie grape belt has given results practically equal to those obtained with lead arsenate, and with comparatively little spray injury, except on certain varieties such as Ives, which constitute a minor part of the total acreage. Although this will not overcome difficulty with arsenic, it will eliminate the lead portion of the residue. In place of second-brood applications of arsenicals, emphasis is being placed on the cultural control methods which have been discussed in earlier reports.

Experimental spraying has been continued with various possible substitutes for arsenicals. The only material showing promise has been nicotine tannate with certain spreaders. Further studies of the effect of cultural-control measures have given very encouraging results. Even though heavy and frequent rains during early May of 1933 and the baking of the soil by excessive heat and dry weather during June interfered seriously with the cultural-control operations, the reductions in berry-moth infestation have been very encouraging.

BLUEBERRY MAGGOT

As indicated in last year's report, the calcium-arsenate dusting method worked out by the Bureau has proved to be a commercially practical and satisfactory treatment for the control of the blueberry maggot. Owing to the practical completion of the investigational work on this project and to the necessity for curtailment in expenditures, work on this insect was discontinued and the laboratory at Cherryfield, Maine, closed at the end of the calendar year 1932.

SUBTROPICAL FRUIT INSECTS

CITRUS RUST MITE

The Orlando, Fla., laboratory has continued to give special attention to the problem of the citrus rust mite and its control. A comparison of russetted fruit with bright fruit not attacked by rust mites has shown that the injured fruit loses weight and shrivels more rapidly than the uninjured. Contrary to popular belief, the russetted fruit contained a higher percentage of acid than the uninfested fruit. It has been found that iron sulphate adds very greatly to the effectiveness of lime-sulphur in the control of this species. The Orlando laboratory is also cooperating with other bureaus of the Department in a detailed study of the effects of lead arsenate and other insecticides on the maturity of citrus fruits.

CALIFORNIA RED SCALE

At Whittier, Calif., the investigation has been continued of the resistance of the red scale (*Chrysomphalus aurantii* Mask.) to fumigation with hydrocyanic acid gas. As basis for the proper timing of controls, an intensive study has been made of the seasonal behavior of the red scale in respect to numbers, vitality, and the proportion, in different seasons of the year, of the stages now known to be most resistant to cyanide fumigation. This study has also covered the behavior of the scale in both coastal and foothill locations and as influenced by picking methods and other orchard operations. The important control

features of the year have been the further demonstration of the efficiency of the combined treatment of oil spray followed by fumigation and the determination of a means of lessening the cost of such treatment. By the development of a "skeleton spray" it has been found possible to reduce the cost of the double treatment by a saving of 30 percent in spray material and upwards of 20 percent in labor and apparently with no loss in efficiency, and with less risk of injury to the tree and fruit. A large part of the weakness of fumigation has concerned the scale on the exterior of the tree. The skeleton spray is aimed at this weakness and consists of a thorough application to the outside foliage of the trees with no effort to penetrate to the interior portions, to be later followed by fumigation. In cooperation with the Bureau of Chemistry and Soils numerous gases have been tested alone and in combination with hydrocyanic acid gas but so far nothing has been found equaling cyanide in toxicity to the scale or indicating an equal margin of safety to the foliage.

CITRUS THRIPS

The citrus thrips in California is primarily a pest of the interior rather than the coastal districts. The work of the year with this pest, hitherto conducted in the San Joaquin Valley, has been centered in southern California. The remedy for the thrips is in dusting with finely divided sulphur and the beneficial results increase in proportion to the fineness of the sulphur. By arrangement with owners, demonstration work in the southern California area is being conducted in six orchards, the full results of which will not be available until the time of harvest. Preliminary surveys have indicated little thrips damage in the orchards given the standard treatment of three dustings. Work has included variation in the number of dustings and, for comparison, spraying with the lime-sulphur wash, the advantage distinctly remaining with the three applications of sulphur dust. Closely related to thrips injury is that due to winds, comparative study of which, conducted in Ventura County, indicates that scarring by winds may be fully as great as that by thrips. The early studies in the Lindsay district indicated that the sulphur dusting gave also satisfactory control for light infestations of the citricola scale. Extensive experiments have, therefore, been carried out in southern California to determine the value of sulphur dust against both the gray and the black scales, results of which must wait winter harvest for determination.

DATE-PALM INSECTS

Further experiments have been conducted with various heat treatments for the control of the red date scale. When the treatment was conducted in dry air, the offshoots lost as much as 20 percent in weight, but seemed to suffer no permanent ill effects. The most practical method of treating the offshoots seems to be to place them in a room maintained at a temperature of 120° F. for a period of 65 hours.

The date mite (*Paratetranychus heteronychus* Ewing) has been found to be readily controllable by the use of sulphur dusts; in the same series of experiments, nicotine dust was found to be ineffective. Information is being obtained as to whether certain desert shrubs and grasses are serving as reservoirs of infestation by these mites, permitting reinfestation of the date palms.

INSECTS AFFECTING MISCELLANEOUS ORNAMENTALS

The attention of the New Orleans station has been devoted chiefly to fundamental studies of oil sprays for the control of the camphor scale and certain other species of scale insects and mealybugs. Experiments with 3 oils having unsulphonatable residues of 67, 84, and 94 percent, respectively, but having other characteristics nearly identical, demonstrated that there was no difference in the insecticidal efficiency of oils having unsulphonatable residues within this range. The field applications to camphor trees of the oil having 67 percent unsulphonatable residue, diluted to contain 2 percent of oil, caused a heavy leaf drop; the other 2 more highly refined oils caused very few leaves to fall. Tests of 3 oils differing only in their viscosities, which were 83.5, 146, and 220 seconds, respectively, showed that their effectiveness increases with each increase in viscosity within these limits. Determinations of the quantity of oil deposited per unit of area were made, following a method developed at the New Orleans laboratory by the Bureau of Chemistry and Soils, which is cooperating with this Bureau in these investigations. The oils having higher

viscosities deposited greater quantities of oil per unit area, which in large measure appears to be responsible for the increased scale mortality.

The biology of a mealybug attacking fig, previously identified as *Pseudococcus citri* Risso, but apparently different in certain respects from the greenhouse form which goes under the same name, has been studied, along with the work with oil and other insecticides for its control. Unfortunately, the oil sprays have been found too injurious to fig foliage to justify their use for the control of the fig mealybug. Investigations of other insecticides now include numerous other contact materials such as pyrethrum, rotenone, nicotine, and certain thiocyanates. For the most part these are dissolved in oil which is then emulsified and diluted below the point of danger of oil injury to the plant, which is below the concentration of oil that is effective alone against the mealybug. Results from this work are not yet available.

SHADE-TREE AND HARDY-SHRUB INSECTS

The work on this project has been carried on, as usual, under the direction of William Middleton and is largely service in character, due to the limited funds available for the work and the wide demand for information. The correspondence has continued especially heavy, the total for the year from the Washington Office being 2,355 letters. Advice on the identity, the prevention of the injury, and the control of insects has been furnished to private owners of trees, to officials, and to tree workers.

Some inspections of tree and shrub conditions were made during the year, including Arlington National Cemetery, the Pan American Union, and the Soldiers' Home in Washington, D.C., and properties of the Williamsburg Holding Corporation of the Rockefeller Foundation, Williamsburg, Va.

The accumulation by observations of data tending to aid in the control of injurious species has continued and some little research has been carried on. This is especially true at the Palo Alto Laboratory in California. The biological and control studies of the cypress bark beetle being carried on at the Palo Alto Laboratory have been continued and distinct progress is being shown in these investigations, although it is yet too early to predict conclusions.

Cooperation with the Gipsy Moth Laboratory of the Division of Forest Insects has been carried on through the liberation of elm-leaf-beetle parasites and by the collection of eggs, both for rearing the parasites at the laboratory and for studies of the survival or recapture of the parasite after liberation.

FRUIT FLIES

Studies of various fruit flies have been continued at the laboratories in Hawaii, Mexico, and the Canal Zone. In addition a special study was begun in November 1932 at Key West, Fla., of the West Indian fruit fly.

HAWAII

At the Honolulu Laboratory much additional information has been obtained on the life history and habits of the Mediterranean fruit fly and the means of its control. Special attention has been given to the study of attractants. All grain baits have been found to be attractive to both sexes of flies but the mixture based on rice middlings, in this respect, has excelled all the others. In the determination of the relative toxicity of various poisons, approximately 25,000 adult flies of known age and parentage have been used in laboratory tests. The four poisons which have proven most effective are copper sulphate, tartar emetic, lead arsenate, and sodium arsenite. The addition to such poisons of certain materials such as fruit juices and especially a combination of ammonia and geraniol has stimulated feeding and thus increased effectiveness. Practical tests of these poisons in mango orchards, now covering a period of 18 months, indicate that even under Hawaiian conditions of general infestation considerable protection can be secured by repeated applications.

MEXICO

The investigation of the Mexican fruit fly (*Anastrepha ludens* Loew) and related species has been continued in Mexico in cooperation with the Mexican authorities. In addition to studies of the habits and host relations of these fruit flies, important additional information has been obtained on the sterilization of various fruits, particularly by the use of vapor heat. Special attention

has been given also to attractants and traps for the collection and destruction of adult flies. The type of glass trap commonly used for house flies in Japan has been found to be very much more effective than other traps for fruit flies in orchards and this trap has recently been adopted for use in the lower Rio Grande Valley by the Bureau of Plant Quarantine. Other work at this station has included further studies on insecticides, and a hitherto unused copper compound has indicated special effectiveness. Practical tests to determine how the material is affected by climatic conditions in the lower Rio Grande Valley are now under way in cooperation with the Bureau of Plant Quarantine.

CANAL ZONE

The work on fruit flies in the Canal Zone concerns four species of *Anastrepha* and also the papaya fruit fly—all New World insects. A continuation of the study of fruit-fly baits has confirmed the superior merit of the tartar emetic bait first indicated in the work of this station the previous year, and this conclusion has been confirmed during the year at the other fruit-fly stations.

Many special subtropical-insect problems have been given attention by the leader of this station, and in two instances he has rendered very valuable service to important fruit-producing interests outside of the Canal Zone. Following a request of the President of Panama, approved by the Department of State, he was authorized to make a special study in the San Blas district of Panama of the serious disease of coconut palms known as "red ring" caused by a microscopic worm (nema). This disease is conveyed from tree to tree chiefly by the palm weevil. A detailed report covering all phases of the problem and presenting practical control recommendations has been submitted to the President of Panama and to this Department. Similarly, at the request of the American Minister in Haiti, endorsed by the Department of State, Mr. Zetek made an inspection, in June 1933, of the "Panama disease" in bananas and plantains in Haiti, the outcome of which was the indication that by careful selection of suckers for planting, this disease, now largely confined to a single plantation, could be eliminated.

It is worthy of note that the parasite of the blackfly imported from Malaya into Cuba and widely distributed in the West Indies and Central America appears completely to have controlled the blackfly in the Canal Zone and Cuba.

KEY WEST

The discovery some 2 years ago of the occurrence at Key West, Fla., of the West Indian fruit fly (formerly known as *Anastrepha fraterculus* Wied. but now determined as *A. acidusa* Walker) led to a preliminary effort on the part of the State to eradicate this pest. As this effort was not entirely successful the State Plant Board of Florida appealed to this Bureau for aid in obtaining exact information as to the biology and host plants of this fruit fly to serve as basis for a more intensive clean-up effort. This study was undertaken in November 1932 and developed much useful information relative to the winter habits and also the relations of this and a related species likewise found to occur there. These studies are being made the basis of a much more intensive and, it is expected, final and successful effort to complete the eradication of this pest in Key West, the only portion of Florida in which it is known to have become established.

JAPANESE AND ASIATIC BEETLES

The work in this field has continued under the direction of C. H. Hadley.

JAPANESE BEETLE

A feature of interest of the year has been the striking reduction in Japanese beetle population in 1933 compared with that of 1932. This was particularly noticeable in the formerly heavily infested sections of Pennsylvania, where in the spring of 1932 the soil population averaged as high as 30 larvae to the square foot, and in the spring of 1933 showed a population generally of less than 7 larvae per square foot. Severe drought in July 1932, during the period when eggs were hatching, appears to have been the important factor causing this reduction. Information secured from soil surveys suggests, however, that

parasitic microorganisms and other natural agencies contributed. On the other hand, during the summer of 1933 weather conditions have been favorable for the egg and early larval stages of the insect. In marked contrast to the reduction in population in the older infested area is an extensive area in southwestern New Jersey where severe injury occurred during 1933. The area of continuous infestation as to all States at the end of the season of 1933 increased from a total of approximately 7,600 square miles at the end of the season of 1932 to approximately 8,600 square miles in 1933. This area includes most of New Jersey, the four or five counties in Pennsylvania surrounding Philadelphia, and approximately the upper half of New Castle County, Del. The density of infestation has also increased in the somewhat separated areas through New York, Connecticut, Rhode Island, Massachusetts, Maryland, Virginia, and the District of Columbia.

During the season, in several instances new growth of certain evergreens (azaleas, rhododendron, juniper, cryptomeria, and arborvitae) was severely attacked by the beetles, where roses and other common food plants near these evergreens had been heavily sprayed for protection, and there was an unusual amount of feeding on clover, alfalfa, bush beans, broccoli, strawberry, lotus, and Japanese barberry.

The effectiveness of the standard Japanese beetle trap has been still further improved and its usefulness, particularly for the protection of the second crop of red raspberries and blueberries, has been further demonstrated.

As a repellent on foliage, the use of lime, in combination with fish oil or linseed oil as a sticking agent, offers promise. Foliage sprayed with rotenone, dihydrorotenone, or derris likewise appears to be more immune to beetle feeding. As contact poisons for the beetle, a number of materials have been tested, with indications that the sodium soaps are more toxic than the potassium soaps, and that the toxicity of rotenone, derris, and nicotine as contacts is increased by the addition of soaps.

As to grub control, it has been found that the efficiency of the lead-arsenate treatment for lawns, etc., may be affected materially by the type of fertilizer used upon treated areas; also, that heavy applications of lime tend to convert the lead arsenate into an insoluble form, making the treatment of little value for the destruction of grubs.

Further tests to determine the reaction of plants to soil treated with lead arsenate, now extending over a period of 1 or more years, indicate that out of 86 perennials 43 were apparently resistant to the insecticide, 19 were retarded in development, and 24 killed. These results, which will be made available to the public, indicate the necessity of making preliminary determination with respect to any type of plant prior to adoption of such treatment.

During the year a number of shipments of parasites, including 13 species, have been made from Japan. Of the imported parasites already established, the situation with respect to *Tiphia popilliavora* Rohwer is very encouraging; this species is very abundant, giving evidence of rapid multiplication, and has continued to spread from points of liberation. Recently established colonies of the introduced *T. vernalis* Rohwer have, in certain instances, developed sufficiently to permit collection from these colonies of enough specimens to distribute colonies in 65 new locations. Field studies on this wasp indicate a very rapid increase and spread in the rolling, hilly areas of eastern Pennsylvania; the flat, sandy areas of New Jersey, however, do not appear to be so favorable for this parasite. In areas where the parasite colonies have become well established, during the summer of 1933 parasitization of Japanese beetle larvae ranging from 7 to 14 percent was observed. Scouting to determine the spread of the fly *Centeter cinerea* Aldrich showed that the areas where the parasite is known to occur had increased about 40 square miles, bringing the total area to approximately 219 square miles. The parasite *Dexia ventralis* Aldrich seems to be holding its own, although no noticeable spread has been observed.

THE ASIATIC BEETLES

The status of the oriental beetle (*Anomala orientalis* Waterhouse) is approximately the same as in the preceding year. The spread of this species has been quite limited, being most noticeable near the old infestation at Jericho on Long Island (N.Y.) and at White Plains, Pelham, and Mount Vernon, in Westchester County, N.Y. Some injury from grubs of this species to strawberries and raspberries has been observed. Injury to turf has for the most part been largely prevented by the application of the lead-arsenate treatment.

The Asiatic garden beetle (*Autoserica castanea* Arrow) continued to spread and in 1933 was found (by scouts of the Bureau of Plant Quarantine) at Aiken, S.C. The finding of this insect at Atlantic City, N.J., also represents a new record. During 1933 this species occurred in greatly increased abundance throughout northern New Jersey, western Long Island, and in Westchester County, N.Y. Extensive plant injury occurred in vegetable gardens in Nassau County (Long Island), especially to peas, cabbages, beets, kohlrabi, swiss chard, parsnips, turnips, spinach, beans, eggplants, and peppers. In early summer the grubs destroyed many plants and later in the season the adults almost completely destroyed plants surviving the grub attack.

The beetles are night fliers and are active when temperatures are above 70° F. Tests to determine the value of light traps showed that the use of an ultraviolet light in a trap resulted in the capture of from 4 to 10 times as many beetles per watt of electricity consumed as when a daylight bulb was used.

CEREAL AND FORAGE INSECTS

The work on insects affecting cereal and forage crops is under the direction of W. H. Larrimer.

GRASSHOPPERS

The grasshopper survey in the fall of 1932 in the northern Great Plains and Rocky Mountain States to determine the location and abundance of eggs showed that, although reductions in infestation had occurred in Nebraska, Colorado, Wyoming, and Idaho, conditions in North Dakota, South Dakota, and northeastern Montana were extremely serious. The resulting infestation in 1933 fully justified the apprehension thus aroused, as severe grasshopper damage developed over practically the whole of North Dakota, central and eastern South Dakota, northeastern Nebraska, and westward over eastern Montana. Although operating under the handicap of considerably curtailed funds, the Bureau detailed not only its regular research men to aid in this emergency but furnished the services of a special expert who devoted his entire time for 3 months to organizing the control work in North Dakota. Through these means it was possible successfully to arouse such counties as possessed sufficient funds for the application of poisoned baits, and this resulted in saving the crops throughout many communities.

In addition to the two-striped, the differential, and the clear-winged grasshoppers, which had caused most of the trouble in recent years in these States, there appeared in 1933 a serious outbreak of the lesser migratory grasshopper (*Melanoplus mexicanus* Sauss.), which has many of the characteristics of the pestilential "Rocky Mountain locust" that devastated the Mississippi River Basin in the seventies and eighties of the last century. Owing to its migratory habits, the advent of this grasshopper over large areas in both the Dakotas and Montana presents the possibility not only of the continuation, but of the extension in the spring of 1934 of the present outbreak.

For the past 3 or 4 seasons the research on grasshoppers has been seriously interfered with by the necessity of doing extension work on methods of control, and in aiding the organization for such work. Progress has, however, been made on methods to determine prospective grasshopper populations—such information to be used as a basis for estimating the need for control and the probable cost. Continued improvement in the baits has been made, particularly along the line of attractants, substitutes for arsenic as a poisoning ingredient, and methods of improving the physical composition of the bait so that it may be attractive to the grasshoppers over a longer period. It has been determined that cane molasses is about as attractive as any other sweet used in bait. When beet molasses is substituted for cane molasses, the addition of amyl acetate is desirable. Excellent results can be obtained during hot, dry weather by use of a bait made up with the simple ingredients of wheat bran, arsenic, and water. The fluosilicates of sodium and barium have given considerable promise as substitutes for arsenic in the bait. More rapid killing of grasshoppers has been accomplished when these materials have been substituted for arsenic but lack of uniformity in results prevents the change in the standard recommendation of arsenic for use in grasshopper baits. In an attempt to produce a bait attractive to grasshoppers over a longer period. various oils have been substituted for water. After trial of many types of vegetable oils, a low-grade, cheap lubricating oil of a viscosity of 40 seconds Saybolt proved to be as good as any. The bait in which such oil was substi-

tuted for water has remained attractive over a much longer period and produced a more sustained killing effect than baits prepared with the usual formula including water. These tests should be continued and the improved baits given further extensive trials in the field before any change in the standard poisoned-bran bait formula is recommended.

Continued observations have verified the advantages, instead of "stubbling in", of plowing stubble as a cultural control for grasshoppers, in that it not only serves to destroy the eggs of these pests but also furnishes a much more desirable seed bed. An emergency circular, designed to furnish timely information on this phase of grasshopper control, was issued in September 1933 for use in the outbreak area.

Small grain crops, sown as early as possible, usually reach maturity ahead of serious grasshopper damage. Further studies have been made on the time of hatching of the eggs of various species of grasshoppers, as such information may have a bearing on the time, as well as the number, of applications of bait on the hatching grounds.

Continued observations on the migratory phases of various species of grasshoppers have been made during the present outbreak, and these studies may later have a practical bearing especially on the species *Melanoplus mexicanus* Sauss., should the latter prove to be a phase of the destructive Rocky Mountain locust of the early Plains days.

MORMON CRICKET

In the elevated plateaus of the Rocky Mountain region a large, black, wingless, long-horned grasshopper popularly known as the "Mormon cricket" breeds periodically in great numbers. In May 1932 an outbreak of this species appeared rather suddenly on the Fort Hall Indian Reservation in eastern Idaho. The suddenness of the outbreak and the lack of familiarity with the species and adequate control measures caused considerable consternation to the officials of the reservation as well as residents of neighboring counties. Upon the advice of Federal and State entomologists, emergency control measures by trenching were largely replaced by the recommended combination of barriers and dusting, and much of the hysteria subsided. The infestation, however, was of such magnitude as to present a real threat to the neighboring cultivated crops and, but for the unusually vigorous control campaign that was conducted, considerable loss would have resulted. While practically all crops were protected, it was impossible to prevent egg laying in the foothills bordering the cultivated areas. As a result, in the spring of 1933 the outbreak was repeated; but through a pooling of the resources of the Indian Service, assisted by the purchase by this Bureau of calcium arsenite dust and dust guns, the control campaign was continued with little or no loss of crops.

There also developed, during the season of 1933, outbreaks of this species in 5 or 6 other isolated places in Idaho, also on the Crow Indian Reservation in south-central Montana; and an old infestation, in the Blue Mountain area in northwestern Colorado, spread eastward toward the cultivated areas in that section. The outlook for next year, therefore, is for considerable trouble from this insect in the areas mentioned.

EUROPEAN CORN BORER

Owing to unusual and unfavorable spring and summer conditions for corn culture in the Great Lakes region of European-corn-borer infestation, the increase in damage by this pest forecast in our report of last year did not develop. Although the rate of infestation and winter survival of the pest was found to be quite as high as in former years, corn was planted throughout this area much later than usual and developed but slowly in the early part of the season. The result was that when the corn borer moths emerged to lay their eggs the corn was too small to be attractive. In addition to this handicap, weather conditions during the egg-laying period continued unusually dry and hot, thus destroying many of the egg masses shortly after deposition. At present, indications point to very little if any general increase in infestation and spread in the one-generation area. In the two-generation area a very perceptible increase in infestation occurred during the season of 1933. Individual sweet-corn fields, under conditions leading to exceptional concentration of the borers, in Massachusetts, Rhode Island, and Connecticut were a complete loss as to marketable ears of sweet corn.

The introduction and colonization of parasites of this pest have proceeded rapidly and satisfactorily during the year. In addition to 666,000 parasites of various species, some 3,400,000 parasitized larvae of the pest were received from Europe. Especial attention is being concentrated on the redistribution of corn-borer parasites in this country, particularly in the eastern edges of the Corn Belt wherever infestation of the pest is sufficiently intense to permit the parasites to obtain a firm foothold. By these methods it is hoped that the parasites may be established as promptly as possible after any given area becomes infested.

A consolidation of the three field laboratories formerly located at Sandusky and Toledo, Ohio, and at Monroe, Mich., became effective July 1 last. General headquarters are now established at 1920 Parkwood Avenue, Toledo, Ohio.

Nine publications treating on various technical phases of the corn-borer investigation were issued by the staff during the year.

HESSIAN FLY

The threatened outbreak of the hessian fly, commented upon in our report of last year, was largely dissipated by drought and high temperatures that obtained in the past summer so that the conditions of infestation prevailing this fall, in most of the wheat-growing areas east of the Rocky Mountains, are much less threatening. Comparatively small areas in several of the States such as Kansas, Missouri, Illinois, and Indiana are still quite heavily infested, but it is believed that the danger of a great general outbreak is over for the present, although the same meteorological conditions which vanquished the threatened general invasion have drastically reduced wheat yields in many localities.

For some years an investigation of the hessian fly as a pest of wheat in the Pacific Northwest has been under way. This work has progressed sufficiently to enable the Bureau to issue a report of it in a teachnical bulletin issued in May of the present year.

SUGARCANE INSECTS

The commercialization of a cosmopolitan egg parasite, accompanied by extravagant claims as to its efficiency in the control of the sugarcane borer, has led to much controversy for some years past among sugarcane growers and others in the Gulf States as well as other sugarcane-producing countries of the world. In order to decide the question of its utility in this relation in a fair and unbiased manner, the Bureau recently has undertaken in Louisiana a comprehensive investigation of the matter and is engaged in the colonization of this parasite (*Trichogramma minutum*) under conditions which it is felt will eventually furnish the growers with reliable information on the subject. During July approximately one half million individuals of this parasite were released for colonization in experimental sugarcane fields under controlled conditions which will permit comparison of results with those in fields not so treated.

The sugarcane borer is the chief limiting insect factor in the production of sugar in the Gulf States and hence much attention has been focused on the importance of control of this pest. Recently it has been observed that some important varieties of cane were much less frequently attacked by the borer than were others. It is believed that this may be due to the variation in the hardness of the rind of the cane, and an investigation of this question is being made. Preliminary results seem to indicate that such variation may be an important factor in the degree of injury inflicted by this pest to sugarcane.

The work of introducing the insect parasites of the sugarcane borer from South America has been recently concluded and a full report of this work was published as a technical bulletin during the year.

PEA APHID ON ALFALFA

The investigation of the pea aphid as an enemy of alfalfa in the Antelope Valley of California has progressed sufficiently to permit the publication of the results and definite recommendations for the control of this pest. Two circulars are being issued containing such information. Until recently it has been somewhat of a mystery how this aphid survived the intensely hot dry summer months in the valley. It has now been discovered, however, that comparatively small numbers of true females appear in late spring which lay eggs that are resistant to desiccation and that aestivate during the dry period and thus perpetuate the pest.

ALFALFA WEEVIL

There has been no important spread of this pest during the year. The appearance of the insect in the San Joaquin Valley of California which was recorded in our annual report of last year required the initiation of an effort to establish its principal insect parasite in this newly infested district. Action taken in the fall of 1932 resulted in the introduction in the spring of 1933 from Nevada of a small colony of this parasite (*Bathyplectes curculionis* Thoms.) and surveys made recently indicate that this effort was successful. There are now being held in cold storage, pending the arrival of the proper season for release, some 13,000 cocoons of this parasite for further colonization in California.

RANGE CATERPILLAR

The project for the colonization of the controlling parasite (*Anastatus semiflavidus* Gahan) of the range caterpillar in northeastern New Mexico has progressed rapidly during the year, in which a total of more than 4½ million eggs have been parasitized at the laboratory at Tempe, Ariz. Of these about 3,500,000 were colonized during the summer of 1933. Unfortunately for this work, however, extreme drought and overgrazing have served greatly to reduce the host insect and have thus interfered seriously with the immediate success of this effort.

CHINCH BUG

A recrudescence of that formidable enemy of growing wheat, other small grains, and corn, the chinch bug, has developed rapidly during the past 12 months. In addition to ravages committed in its usual range through Iowa, Kansas, Missouri, Illinois, and Indiana, it appeared in the cornfields of eastern Pennsylvania in such numbers as to cause general complaint. One unusual development was its appearance in Vermont and in the Catskill Mountains of New York, where it injured lawns and golf greens to some extent. Where the barrier methods of defense for cornfields, developed by Bureau and State entomologists, were utilized in time, these proved effective. The relationship of drought to chinch-bug abundance has elsewhere been noted (p. 2).

Early in September at a meeting of State and Federal entomologists at Hamilton, Ill., the best methods for control of the chinch bug were discussed and a uniform plan to meet the chinch-bug situation in the Corn Belt States was adopted. Briefly, this plan of attack includes (1) the adjustment of crops to better fit into control measures, such as the elimination of barley and millet and the substitution of winter wheat in such rotations, the growing of soybeans, and the planting of chinch-bug-resistant varieties of corn; (2) winter burning of bunch grass, leaves, and other debris along fences, hedgerows, and borders of wood lots, where practicable, to destroy the hibernating quarters of the overwintering bugs; (3) the use of barriers to prevent the migration of young, first-generation bugs from small grain to corn; creosote barriers or barriers of coal tar which contain the maximum of phenols and cresols, as well as naphthalene, are most effective.

WHITE GRUBS

The past year has been characterized by rather widespread and intense injury to pasture lands and field crops by various species of white grubs from the Atlantic seaboard to Iowa. An intense local outbreak in Loudoun County, Va., was investigated by Bureau experts and as a result recommendations for control in that locality were published in a regional agricultural periodical. The condition in the North Central States was deemed serious enough to require the resumption of the general investigation of white grubs formerly carried on there with La Fayette, Ind., as a base. An expert released from another project has been transferred there to resume this project.

LEAF HOPPERS

That the importance of leaf hoppers as pests of forage crops is not sufficiently realized was shown during the year by an experiment conducted with the bean leaf hopper on Alfalfa at the Arlington Experiment Farm. The results of this indicated that where heavy infestation of this insect occurs it may reduce the crop at least 25 percent and also reduce the grade of the resulting hay crop materially.

A bulletin giving general information on the control of leaf hoppers in cereal and forage crops was issued last October.

SOUTHWESTERN CORN BORER

A cultural control satisfactory for adoption in much of the area infested by this insect (*Diatraea grandiosella* Dyar) has been determined during the year. This information and many other facts regarding the significance of this pest to the corn culture of the Southwest are contained in a comprehensive technical bulletin at present in press.

CLOVER-POLLINATING BEES OF THE PACIFIC NORTHWEST

A study of the identity and habits of the bees chiefly concerned in the pollination of red clover in the Pacific Northwest has been in progress for several years as a minor project of this Bureau. The results show that in western Oregon the most effective species is a bumblebee, *Bremus vosnesenskii* Redoszkowski, while in eastern Oregon, especially in Malheur County, the chief pollinators, contrary to popular belief, are the honeybee and leaf-cutter bees.

TRUCK CROP AND GARDEN INSECTS

Investigations of truck crop and garden insects have been continued during the past year under the direction of W. H. White and P. N. Annand.

WIREWORMS

Study of the irrigated land wireworms has been continued in Washington and California, of the sweetpotato wireworm (*Heteroderes laurentii* Guér.) in Alabama and Mississippi, and of the sand wireworm in South Carolina. The long life cycle of most of these pests, their underground habitat, and their surprising tenacity of life, preclude the effective use of remedies applicable to other insects. The means of control of wireworms which seem to have practical value fall into two classes, namely, chemical and cultural. Of the first, soil intermixture with carbon disulphide or with crude naphthalene, when carried out under proper conditions of soil temperature, has given satisfactory results in the irrigated sections of the Northwest. Treatment with carbon disulphide costs about double the treatment with naphthalene but is more effective, giving substantial freedom from this pest for at least 3 years. It is applied by injections of 1 ounce of the liquid to a depth of about 4 inches in the soil at intervals of about 18 inches. The application of crude naphthalene is made by thoroughly mixing it in the upper 10 inches of soil at the rate of 800 pounds per acre. In test plots this treatment has given a kill of 85 to 95 percent of the soil population of wireworms. To obtain the best results with either chemical it is necessary that the soil be in a good state of tillage and its temperature above 70° F.

As to cultural means, a careful study of soil moisture and temperature in their relation to wireworm populations has given the clue to the control of these pests. A high mortality is secured by allowing the soil to become extremely dry or by flooding the land after crop harvest. These methods are particularly applicable to irrigated areas. In the case of flooding, temperature is again an important factor, and this method to be most successful should be practiced during July and August. At temperatures below 60° F. submerged wireworms may survive for long periods. In one experiment of a week's duration where the temperature of the submerged soil reached 75°, from 95 to 100 percent of the wireworms were killed.

As to soil desiccation, laboratory tests have shown that wireworms cannot survive longer than 48 hours where the soil humidity is lower than 90 percent. Field tests where soil of irrigated lands was allowed to dry throughout the surface foot to this percentage, and remained so for several weeks, exhibited a marked reduction in wireworm populations. It is suggested that in carrying out this means a system of rotation be adopted which will give this control every 4 or 5 years.

In the case of the sand wireworm, the work of the past season has indicated successful control by absolutely clean cultivation for 60 days or more during February, March, and April—except as to cotton fields, where the roots appear to remain sufficiently succulent to support these pests over the period. This

wireworm has a 1-year cycle only and therefore there is a period during each year when the soil is relatively free from them. Studies of crop rotation as a means of reducing damage by this wireworm are now under way.

BEAN INSECTS

MEXICAN BEAN BEETLE

The spread of the Mexican bean beetle has been less extensive than during 1932, although one long-distance jump to Minnesota has been reported. The survival of the bean beetle in the Northern States has been progressively higher with increased damage for several years, probably owing to the milder winters which have prevailed.

Field and laboratory tests of comparatively new insecticides have been continued in Ohio and the Norfolk, Va., area and the following results seem to be quite conclusive: Potassium hexafluoaluminate and synthetic cryolite are satisfactory for the control of the Mexican bean beetle when used as sprays at the rate of 3 pounds to 50 gallons of water. Barium fluosilicate (80 percent) used at the rate of 5 pounds to 50 gallons of water gives satisfactory control. Fluorine compounds have not given satisfactory control when used as dusts. The current recommendations for the use of magnesium arsenate should be adhered to except that where the infestation is heavy the dosage should be increased from 1 to 2 pounds to 50 gallons of water.

In the Estancia Valley of New Mexico practical field experiments have shown that undiluted calcium arsenate is the cheapest material for use against the Mexican bean beetle and that no plant injury results in that district with applications of 4 to 6 pounds per acre.

From the standpoint of poisoning residues on edible portions of the plant, it has been shown that applications of the stomach poisons mentioned, up to the time the pods form on bunch beans, usually give sufficient protection to the crop and avoid the problem of poisonous residues. Should the crop require spraying after the pods have set, pyrethrum or derris extracts must be used.

The tachinid parasite *Paradexodes epilachnae*, introduced from Mexico in 1930, has been reared continuously for approximately 32 generations. During the calendar year 1932, 18,642 flies were liberated in 14 States, making a total of 16 States in which the parasite has been liberated. Remarkable increases during the same season of liberation were found to have taken place in some localities, but to date no authentic records have been obtained of recovery of the parasite a year subsequent to the liberations.

MISCELLANEOUS BEAN INSECTS

Studies of the bean leaf hopper (*Empoasca fabae* Harr.) were carried on in Florida and showed that both Bordeaux mixture and sulphur, the latter used either as a spray or a dust, are effective in reducing infestations.

The work on the lima bean pod borer in California has shown that the first brood develops on wild lupine and the moths then migrate to lima beans, where one brood and a partial second develop. Distance between the wild hosts and cultivated crop has been shown to be important in determining the amount of damage caused by this pod borer. Extensive tests have been made with insecticides in an effort to reduce the losses to the bean grower, not only from injury to the dried bean but also to the green product, and indications have been obtained that worth-while control of this pest can be obtained by the use of undiluted cryolite. No estimate of loss from damage to the green product is available, but in the case of dried beans the loss from injured beans has amounted to about $1 per 100 pounds. This includes the labor item for removal of injured beans.

BEET LEAF HOPPER

The investigations on the beet leaf hopper have been continued in Utah, Idaho, Colorado, Oregon, and California. Injury by the pest has not been generally severe during the past year except in the Grand Valley in Colorado.

The seventh annual forecast of leaf-hopper abundance, made for the Twin Falls area this year, indicated previous to planting that populations for the season would be low, and the results have confirmed the accuracy of this forecast. Work has been continued at Twin Falls, Idaho, on control of the leaf

hopper by spraying areas of concentration in the desert previous to hibernation in the fall and to migration in the spring. Investigations of the importance of parasites in the control of this pest are also being conducted in an attempt to determine their effectiveness under various conditions and the possibility of utilizing them in control.

No forecast was issued for the Grand Valley in Colorado this year because of uncertainty as to the importance of a large Arizona breeding area of the insect which carried high populations. A large migration of the leaf hoppers apparently occurred from this area in early spring. Its serious nature was recognized immediately and growers were warned to keep their beets in the best of tilth and moisture conditions possible as a means of reducing injury. A continuance of the service in western Colorado will be possible only when more definite information is available as to the importance to the Grand Valley, Colo., district of the breeding areas in Arizona. Eastern Utah breeding areas are important to the Grand Valley in some seasons, but even when low overwintering populations occur here severe injury may result to beets if the Arizona areas are heavily populated.

Further studies in Utah have established rather definitely the fact that the insects responsible for the injury to beets in the central Utah sections originate in the large breeding areas in southern Utah and portions of Arizona and Nevada, and it now appears feasible to forecast conditions for at least a portion of the State.

Direct control operations have been continued in California by spraying the wild host plants chiefly concerned in the fall concentration in the valleys bordering cultivated areas. It is believed that at least 50 percent reduction in beet-field populations has followed such fall spraying. The final tests of the efficiency of this method will come when there is a major increase in populations as a result of climatic conditions favorable to the insect. Destruction of summer hosts, particularly of Russian-thistle, favorably located in the foothills with reference to breeding areas, has been found to be an important factor in reducing populations.

TOBACCO INSECTS

Material reduction of hornworm infestation has been obtained in the Kentucky and Tennessee tobacco districts and in the shade-tobacco districts in Florida by the use of a bait consisting of tartar emetic in combination with amyl salicylate as an attractant to the moths. Such baiting afforded commercial protection from hornworms until the latter part of the harvesting season, when one application of an arsenical was necessary. To secure control on untreated fields an average of 4 to 5 applications of arsenical, together with hand pickings, was required. A series of comparative counts indicated that an approximately 89-percent control resulted from the use of bait.

BERRY INSECTS

Detailed information has been secured on the seasonal history of the raspberry fruit worm, a serious pest in the berry-growing districts of Washington and Oregon. It is found that 51 percent of the larvae and pupae in the soil are within 2 inches of the surface, that 95 percent are within 4 inches, and that cultivation to these depths has killed a good percentage of such larvae and pupae. Extensive tests with sprays have indicated that early applications are most effective in preventing bud damage, but that later applications are necessary for reduction in fruit infestation. A spray which can be used during the latter period without danger of poisonous residues is being sought.

Of a number of mites found causing damage on various varieties of blackberries in western Washington, the red berry mite (*Eriophyes essigi* Hassan) has become a serious pest. It has been found that wettable sulphur, generally used for mite control, may result in injury to blackberry vines under certain conditions. A study of the spread of this pest indicates that scattered infestations occur throughout the area, but that the most general occurrence is in the Puyallup Valley.

Studies of the strawberry root aphid, *Aphis forbesi*, in North Carolina have definitely shown that this aphid is responsible for the death of many of the strawberry plants. However, the dying of plants which has been previously attributed to aphid injury to the root may be caused by other factors, such as

low soil moisture and root rots. Injury is less in new land and is greater in plantings following strawberry, corn, and cotton than in fields which have been allowed to grow up in weeds or grass.

PEPPER WEEVIL

Tests in California on the control of the pepper weevil have shown that calcium arsenate, barium fluosilicate, cryolite, and potassium fluoaluminate are toxic to the weevil, but the fluorine compounds, with the exception of potassium fluoaluminate, even when diluted 50 percent with a neutral carrier, injured the plants, causing some leaf burning and especially dropping of the buds. Damage was much more severe when the foliage was damp or wet than when it remained dry. Calcium arsenate dust still remains the best insecticide for use against the pepper weevil, but it is essential that measures be taken to remove all residues from the fruits.

Further studies of host plants show that the weevil survives during the winter for any length of time only on nightshade and peppers. This emphasizes the value of clean-up, such as plowing up of pepper fields and destruction of nightshade, as soon as the peppers are harvested. Such clean-up has apparently greatly reduced the pepper-weevil population and commercial damage the following year, and it is encouraging to note that the growers are becoming more interested each season in the destruction of such winter hosts.

CELERY INSECTS

The celery leaf tier (*Phlyctaenia rubigalis* Guen.) was not so serious during the past season in Florida as in 1931, but it caused considerable loss in California, where many carloads of celery were seized as a result of excess residues from arsenicals used in attempts to control the tier. These seizures could have been avoided if a pyrethrum dust had been used instead of an arsenical, and according to results obtained on control of this pest in Florida much more satisfactory control would have been obtained. Sufficient information on the seasonal development of this insect has been obtained in Florida to make it possible to inform the growers this year that control would be unnecessary, and thus to save considerable outlay for pyrethrum materials and to prevent their needless application. Fluorine sprays or dusts have not given satisfactory control of the celery leaf tier.

Bait tests for the control of mole crickets have given indications that adults in the spring and early summer are more easily baited than are the nymphs and adults in the later summer and fall. Paris green at the rate of 5 pounds per 100 pounds of mixture is the most satisfactory poison. It has been definitely shown that dry bait is more effective than the wet bait which has been usually recommended.

SWEETPOTATO WEEVIL

Efforts to reduce the infestation of the sweetpotato weevil in Mississippi and Alabama have been continued with satisfactory results. Many farms have been released from State quarantine as weevil-free during the past year in Mississippi. Near Mobile Bay in Alabama a small outbreak of the sweetpotato weevil occurred adjacent to marshes in which were infested morning-glories. Less than 8 acres were included in this infestation. A survey of the adjacent marshes revealed a number of infested patches of morning-glory. The possibility of removal of these morning-glories and the seaside morning-glory in the infested area is under investigation. Cooperation was extended to the State of Georgia in controlling a new infestation which appeared along the coast near Brunswick. Test fumigations of stored seed sweetpotatoes indicate the possibility of eliminating danger of infestation from this source, without seriously affecting the germination of the seed, by fumigation with paradichlorobenzene.

CABBAGE WORMS

A study of the means of control for the various species of cabbage worms is being conducted in North Carolina and South Carolina and in Louisiana, more particularly in relation to the avoidance of harmful residues in the marketed product. These studies indicate that paris green and lime (1:10), lead arsenate and lime (1:5), and calcium arsenate and lime (1:5) can be applied to cabbage under Louisiana conditions, regardless of the number of applica-

tions, up to 20 days before maturity without risk of exceeding the legal tolerance. Applications made during wet periods resulted in slightly smaller residues. The amounts of residue resulting from paris green, lead arsenate, and calcium arsenate applications were about the same at harvest when equal numbers of applications of each were made. Studies on the development of the plant indicate that all leaves likely to receive any of an insecticide applied during the first half of the growth period are shed from the plant before harvest. Arsenical residue exceeds the tolerance limits only when leaves that are on the plant at the time of final application of arsenicals are present in the marketed product.

These tests have shown, however, that neither paris green, nor lead arsenate, nor calcium arsenate will give as effective control of larvae of the diamondback moth, imported cabbage worms, and cabbage loopers as will derris dusts containing 1.75 percent of rotenone applied at the rate of 12 to 15 pounds per acre, or pyrethrum dusts containing 0.12 percent of pyrethrin I and applied at the same rate. Hellebore was found to give better control than the arsenicals, but was considerably inferior to the derris and pyrethrum products. At present the cost per application of the organic materials, which do not have poisonous residues, is considerably in excess of that of the arsenicals.

GREENHOUSE AND BULB INSECTS

THE BROAD MITE AND THE CYCLAMEN MITE

It has been found that the broad mite (*Tarsonemus latus* Banks) feeds on 49 species of host plants and the cyclamen mite (*T. pallidus* Banks) on 25, of which 16 are attacked by both species.

Sulphur dust was the most effective of nine materials tested against the broad mite, but only low kills were obtained against the cyclamen mite. Repeated fumigation with naphthalene with dosages of from three eighths of an ounce to 1 ounce per 1,000 cubic feet of space controlled the broad mite but was ineffective against the cyclamen mite. Earlier workers reporting successful control of the cyclamen mite by naphthalene were probably working with the broad mite. In further tests with heat treatments a 10-minute immersion in water at 110° F. killed the cyclamen mites on small plants, whereas a 15-minute immersion was required to kill both the cyclamen mite and the broad mite on large plants. On large delphiniums, however, a 25-minute immersion was required to kill the cyclamen mite in the crown below the soil surface. A 30-minute treatment with vapor heat at 110° and 100 percent relative humidity killed the mites as did also the 15-minute hot-water treatment.

GLADIOLUS THRIPS

The gladiolus thrips (*Taeniothrips gladioli* M. and S.) has become widespread and has continued to damage whole crops. This thrips has not been found to overwinter out of doors in the North. In further tests the thrips on stored corms were killed by application of naphthalene flakes or by immersion in Semesan. Small-scale tests showed that control can be obtained by storing corms at controlled temperatures of 36° to 40° F. for 3 months, a practice which will be desirable for use by large growers. In field tests best control on the growing plants was obtained with weekly applications of paris green brown-sugar spray, particularly when spraying operations were started early. The spray injury was not serious and did not reduce the quality of the flowers or of corm production.

Laboratory and greenhouse studies of the gladiolus thrips indicate that the effectiveness of the paris green brown-sugar spray is due to the toxicity and lasting qualities of the deposit it leaves on the foliage. Molasses is a very effective substitute for brown sugar and the combination of it with other insecticides, such as derris extract (rotenone concentration 1–20,000=0.05 percent) and hellebore appeared very promising. The toxic deposit left by the derris extract-molasses spray on gladiolus retains its effectiveness for a much longer period than other derris sprays, even when exposed to direct sunlight. Neither pyrethrum extract nor the nicotine sulphate-molasses spray was efficient though the molasses-nicotine was the most effective of the various nicotine sprays.

BULB INSECTS

Further studies at Sumner, Wash., with the vapor-heat treatment of narcissus bulbs indicated that complete mortality of the larvae of the larger bulb fly (*Merodon equestris* Fab.) was obtained with a treatment of 1¼ hours and of the larvae of the lesser bulb flies (*Eumerus* spp.) with treatment for one half hour at a temperature of 111° F. For safe, practical application, however, the duration should be 2 hours. This treatment has now been authorized by the Bureau of Plant Quarantine as an alternate method for treating bulbs infested with bulb-fly larvae to meet the conditions imposed by the bulb-quarantine regulations on interstate shipments of bulbs.

The results of this year's studies with field-grown stocks indicate that practically all classes of hardy narcissus tolerate the treatment at 111° F. for 4 hours, provided it is done after a week or more of curing, following digging, and before the bulbs show root or leaf growth. Field-grown stocks appeared to be stimulated by the treatment, since an increase in yield over that of the untreated bulbs was noticed. Under conditions of the Pacific Northwest the treatment of forcing stock must be done in quantities small enough to avoid exceeding a 2-hour approach period, and with a heating period of 2 hours at 111°. Higher temperature limits appeared possible for the stocks grown at Babylon, N.Y. Fumigation with sodium cyanide between August 1 and September 15 showed no detrimental effects on the growth of bulbs in the field, nor was there any particular seasonal variation noted.

MUSHROOM INSECTS

Investigations conducted cooperatively with the Bureau of Chemistry and Soils have shown that calcium cyanide when used as a fumigant in mushroom houses at peak heat reached maximum concentration (7.5 to 8.4 mg per liter) within 15 minutes and that concentration of the gas decreases almost as rapidly. The rapid absorption of the gas is due to the combination of high temperature and excessive moisture. The higher concentration was obtained with less material when sodium cyanide was used in the "pot" method, but the gas was taken out of the air just as rapidly.

Experiments with composting manure heaps conducted in cooperation with the Bureau of Plant Industry clearly showed that the central portions of the heaps are too hot for pests to survive. Proper ventilation of the heaps at ground level raises the temperature in the lower part of the pile to a point fatal to insects.

COTTON INSECTS

Investigations on insects attacking the cotton plant were conducted under the direction of R. W. Harned.

BOLLWEEVIL

The records of field-plat tests of the current season will not be available until the cotton has matured and the yield records of experimental plats and fields have been obtained. Preliminary examinations indicate a range of from 150 to 250 pounds per acre of gain from poison dusting. The mixture of lime and calcium arsenate in equal parts, which is again being tested in South Carolina, indicates, in field tests, results about as satisfactory as those from calcium arsenate alone, but comparable cage tests with this mixture indicate a 50-percent kill as opposed to a 77.5-percent kill with calcium arsenate alone. Cage tests with three different brands of calcium arsenate indicate considerable variation in effectiveness, the mortality ranging from 68.7 to 77.5 percent and 85.5 percent, with 7 to 12 percent mortality in check cages.

A special line of experiments are under way this year involving comparison of dry mixtures of 25 percent paris green and 75 percent calcium arsenate with wet mixtures, both being factory products. The results of field tests are not available but the cage tests indicate a higher toxicity with the dry than with the wet mixture. This reverses results of previous tests, but this year probably a much better mixture was secured through more accurate factory mixing.

As appropriate to a fiscal-year report, the following record deals largely with the results of experimental work available in the fall of 1932: The early season indications of severe bollweevil damage for 1932 following the very

mild winter of 1931–32 were borne out by the Bureau of Agricultural Economics' estimated loss of 15.2 percent by this insect—the greatest damage reported since 1927. In only 5 previous years, 1920, 1921, 1922, 1923, and 1927, has the weevil destroyed so much cotton. In Virginia the weevils caused a greater reduction in yield than during any previous year, while in Tennessee, Georgia, Alabama, and Mississippi the yield was reduced more than in any year since 1923. As a result of this heavy infestation an unusually large number of weevils entered hibernation in the fall of 1932. The spring (1933) Spanish-moss examinations in 4 States and the hibernation cages located in 6 States showed a survival lower than usual except in South Carolina. However, the weevils entered hibernation in such abundance in the fall of 1932 that in spite of the heavy winter mortality enough survived to cause a large initial weevil population in the spring of 1933. This outlook for a second year of heavy damage was changed in many sections by the excessively hot, dry weather in June and July, which effectively checked weevil development. This year's infestation in general has been average but characterized by much variation or "spottiness", caused to a large extent by localized rains.

NEW AREAS INFESTED

Conditions were favorable for the spread of the bollweevil into new territory during both 1931 and 1932. Scouting in November 1932 showed that the line indicating both the limits of commercial cotton production and the bollweevil in Virginia is from 30 to 50 miles north of the previously reported bollweevil-infested area. The northernmost point of known occurrence of the bollweevil in the United States is Sweet Hall on the Pamunkey River, about 9 miles north of West Point, Va. This is slightly farther north than the weevil has been reported in southern Kansas and southern Missouri. In northwestern Oklahoma, Woodward County became infested with bollweevils for the first time in 1932 and weevils were found farther north than they had previously been recorded in the counties of Dewey, Major, Alfalfa, Grant, and Kay. In all of these counties the weevils reached the northern limits of commercial cotton production, as was also the case in Chautauqua and Montgomery Counties, Kans.

CONTROL

Bollweevil investigations were continued at Tallulah, La., and also in Oklahoma, South Carolina, and Texas, in cooperation with the experiment stations of those States.

All the series of plats in different localities dusted with calcium arsenate after 10-percent infestation had been reached—this being an index to the time for applying weevil control—gave sufficient increase in yield to show a profit from dusting, even with the low prices of cotton prevailing in 1932. The calcium-arsenate-dusted plats at Florence, S.C., gave a gain of 176 pounds of seed cotton per acre, or 23 percent increase over the checks; at Tallulah, La., the gain was 572 pounds of seed cotton, or 46 percent increase; while at Eufaula, Okla., the gain was 651 pounds of seed cotton, or 111 percent increase.

Farmers, in attempting to apply poison when the 10 percent index has been reached often find, especially following the more active field migration of weevils in the summer, that the square infestation may range up to 90 percent. In order to determine the possibilities of control under such conditions two tests were made at Tallulah during the summer of 1932 on very fertile land where the cotton could be expected to continue fruiting until late in the season. In the fields selected, weevil activity had been such that only a very light crop of bottom bolls had set. The first test concerned an area where more than 87 percent of the squares had been punctured. Beginning July 19, 14 applications were made of calcium arsenate, each averaging more than 7 pounds to the acre. Although at no time during the test was square infestation brought below 20 percent, yet the yield per acre in the treated plat was 2,126 pounds of seed cotton as compared to 507 pounds in the check plat, an increase of over 319 percent, or, on the basis of cotton at 5 cents per pound, a profit of $22.11 per acre above all expenses. In the second test, started on August 4, when 88 percent of the squares were punctured, 9 applications of calcium arsenate averaging more than 6 pounds to the acre per application were made, and although the square infestation was never brought below 37 percent yet the yield per acre in the treated plat was 1,896

pounds of seed cotton as compared to 1,079 pounds in the check plat, an increase of 817 pounds, or over 75 percent, or a profit of $10.48 per acre with cotton at 5 cents.

Tests in Oklahoma and South Carolina again showed that dependence upon the use of 1-1-1 molasses-calcium arsenate mixture alone does not give satisfactory bollweevil control. However, in 1932 when weevils were abundant early in the season the combination of early poisoning with the 1-1-1 molasses mixture followed by calcium arsenate dust after 10 percent infestation averaged slightly more economical gains in both States than any other treatment.

In Oklahoma one presquare application of the molasses mixture followed by calcium arsenate dust as needed after 10 percent infestation gave an average increase of 560 pounds of seed cotton per acre, or 82 percent increase. In South Carolina three early applications of the 1-1-1 mixture and five later applications of calcium arsenate dust after 10 percent infestation produced an average gain of 366 pounds of seed cotton per acre, or 65 percent increase. The use of molasses-mixture applications in South Carolina seems to have a tendency to reduce the early plant-lice infestations which sometimes follow cotton dusting for bollweevil control.

In South Carolina, where arsenical injury occurs on certain sandy soils from the use of excessive quantities of calcium arsenate, particular attention is being paid to methods of reducing the total quantity of calcium arsenate necessary for weevil control by presquare applications of molasses mixture and by mixing builders' lime with the calcium arsenate. Tests at Florence, S.C., in 1932, using a mixture of builders' lime and calcium arsenate in equal parts for bollweevil control, gave about as good results as calcium arsenate alone.

In view of the pending legislation requiring that arsenical insecticides be colored as protection against accidental use in food, the Manufacturing Chemists Association of the United States requested that tests be made to determine the effect upon insects and cotton plants of the addition of coloring agents in calcium arsenate. In a large series of cage tests at Tallulah, La., and Bryan, Tex., and field-plat tests at Tallulah and Florence no appreciable difference was noted between the colored and standard white calcium arsenates supplied by the different manufacturers.

In a preliminary study of bollweevil parasites in Madison Parish, La., during 1932, parasitization at its highest averaged slightly less than 10 percent. About 90 percent of the parasites were *Microbracon mellitor* Say. Other species reared were *Catolaccus incertus* Ashm., *C. hunteri* Cwfd., *Eurytoma tylodermatis* Ashm., and *Eupelmus cyaniceps* Ashm. These studies have been continued during 1933 at Tallulah and also at Natchez, Miss., where field experiments are in progress in an effort to develop a method of making practical use of parasites in bollweevil control.

HOST PLANTS

On account of the importance of host plants other than cotton in any bollweevil-eradication plan, investigations of this subject were resumed at Tallulah in 1932 and continued again this year. Freshly emerged cotton-bred weevils before they had fed were caged with a number of malvaceous plants. On only one of these, althea (*Hibiscus syriacus* L.), were weevils reared to maturity. On this plant the weevils reached maturity, deposited eggs normally in the flower buds, and three female weevils developed and emerged from the buds in 1932, and in 1933 10 weevils had emerged by September 2. In 1933 althea was planted among cotton on the laboratory grounds, and during August 6 weevils emerged from buds collected from these plants. This is particularly important, as it is the first record of bollweevils breeding under natural field conditions on a host plant other than cotton and *Thurberia*. Tests with other possible host plants were all negative although bollweevil eggs were deposited externally on the seed pods of *Hibiscus militaris* Cav. and *H. lasiocarpus* Cav. The larvae hatching from these eggs were placed in seed pods of those plants but soon died without feeding. No eggs were deposited on hollyhock (*Althea rosea* Cav.) or okra (*Hibiscus esculentus* L.). The only previous record of bollweevils developing in plants other than cotton or *Thurberia* was made at Victoria, Tex., in 1913, when two males were reared under cage conditions from this same althea.

Experiments to obtain an attractant for the bollweevil have been continued but no material has yet been discovered that gives promise of being of value.

THURBERIA WEEVIL

Studies of Thurberia weevils which have been removed from their native host plant and bred continuously on cotton to note changes in habits and adaptability over a period of years are now in their seventh year and indicate that the weevils are becoming more adapted to cotton. There are two or more generations annually on cotton, probably because of the longer fruiting season, instead of one generation as on *Thurberia*. The Thurberia weevils bred on cotton show a decided preference for bolls, whereas squares are preferred by the bollweevil. Fortunately the Thurberia weevils retain their original habits of hibernating as adults within the pupal cells in cotton bolls, instead of emerging and seeking shelter, as does the bollweevil. This habit confines the hibernating weevils to the cotton fields and makes possible control by clean-up and sanitary field conditions. The survival is many times higher, however, than it is for the bollweevil.

The damage to the 1932 crop of cotton in the Santa Cruz Valley of Arizona was much less than for the previous year. The low infestation was due to the fact that most of the weevils from the previous crop had either been destroyed or caused to emerge from hibernation by cultivation and irrigation early in the season before cotton was available, and to the fact that there were no summer flood waters to wash infested *Thurberia* bolls down from the mountains. The damage last year to an isolated planting of Pima cotton in close proximity to mountains with infested *Thurberia* was the greatest observed during the 3 years since it has been under observation, the infestation averaging, by the end of the season, over 40 percent of the bolls. All of the evidence indicates that the Thurberia weevil readily transfers from *Thurberia* to cotton under the conditions found in the principal cotton-producing areas of southeastern Arizona.

BOLLWORM

The bollworm did not cause so much damage to the 1932 crop in most sections as usual, but in 1933 the damage was above normal over large areas. Studies of the causes of its sporadic abundance, which are being continued in cooperation with the Texas Agricultural Experiment Station, indicate that the physical condition of the cotton plant is an important factor in determining the degree of infestation. On the more succulent, fast-growing cotton, more eggs are deposited, a larger percentage hatch, and more young larvae are successful in entering the bolls. The loss in both eggs and newly hatched larvae is heavy from dislodgement by mechanical agencies; and while parasites and predators destroy some, they were not so important as the mechanical agencies in destroying the eggs under observation at Spur, Tex., and the Brazos bottoms in 1932. Careful records on four varieties of cotton showed no varietal difference in infestation. In toxicity tests with several kinds of colored calcium arsenate the standard white and colored samples were equal in killing the bollworm.

COTTON FLEA HOPPER

Field headquarters for investigations of the cotton flea hopper and related insects were moved during 1933 from Tallulah, La., to Port Lavaca, Tex., in response to an appeal from planters and business men of the Texas Gulf coast district for assistance in controlling these insects following severe damage in 1932. The damage by the flea hopper is an annual occurrence in this section, and with the splendid local cooperation good opportunities for field-control experiments are available.

The results of last season's work under controlled cage conditions at Tallulah proved definitely that the damage caused by the cotton flea hopper is principally to small squares (flower buds just as they are formed), with occasional slight damage to large squares, whereas the tarnished plant bug and the cotton plant bug injure and cause shedding of large squares and bolls as well as small squares.

Cage toxicity tests in 1932 with sodium fluosilicate and field tests in 1933 with the fluosilicates of sodium and barium gave good control. These fluorine compounds, however, are not altogether satisfactory for applications as dusts and also have caused some injury to foliage. Sulphur is as effective in killing the nymphs but is less toxic to the adults and is slower in killing than the fluosilicates. Dusting with sulphur in field tests at Port Lavaca in 1933 gave

fairly high percentage control against the flea hopper, amounting to an increase of 248.3 pounds of seed cotton per acre, or nearly a 40 percent increase over the check. Several other insecticides were tested on a field basis this year but the yield records are not yet available. Derris root (2.4 percent rotenone) gave a good kill of the tarnished plant bug and acts very quickly but was not so effective against the flea hopper.

Studies of host plants at Port Lavaca show that goatweed (*Croton* spp.) is by far the most important plant for fall oviposition and winter carry-over of flea-hopper eggs and that relatively few pass the winter in cotton stalks. Rain greatly stimulates hatching of the overwintering eggs which extends well into the summer. Horsemint is the most important early-spring plant for breeding flea hoppers in eastern Texas and an enormous population is bred up on this plant which migrates to cotton when the plants reach maturity during May. Sweeping records, flight screens, and field inspections showed a continuous migration from weeds to early cotton, with heavy migrations during periods of rain and high winds. The large areas on which the principal spring and fall host plants, horsemint and croton, grow are important factors in producing severe hopper damage in this section and suggest possible control by reducing the host plants which carry the flea hopper through the winter and spring months.

PINK BOLLWORM

The cooperative investigations of the biology and control methods for the pink bollworm have been continued with the Texas Agricultural Experiment Station and with the Defensa Agricola of the Mexican Department of Agriculture. The station at El Paso, Tex., was closed on June 30, 1933, and Presidio, Tex., is now field headquarters for all of this Bureau's investigations of the pink bollworm.

Calcium arsenate, sulphur, calcium cyanide, nicotine sulphate, and sodium fluosilicate gave some indications of control in 1932 and further tests with these and other insecticides are being conducted this year.

Six chemicals—oil of anise, terpinyl acetate, trimethylamine, ammonium hydroxide, gossypol acetate, and ethyl cinnamate—which have been used as baits for other insects were tested as attractants for the early emerged pink bollworm moths at Presidio this spring, all with negative results.

The parasites *Microbracon brevicornis* Wesm. and *Exeristes roborator* Fab. readily attacked the pink bollworm and were easily bred in the laboratory. A special air-conditioned insectary has been constructed at Presidio for the work of rearing parasites in quantity for release in the fields. The first field liberation of *M. brevicornis* made last October at Presidio apparently did not become established. A shipment of this species was made in July 1933 for release in the fields of the Laguna district of Mexico where the pink-bollworm infestation builds up earlier in the season than in Texas. Native parasites were found attacking the pink bollworm in the vicinity of Presidio for the first time in the spring of 1933. *Microbracon mellitor* Say, *M. platynotae* Cush., *Elasmus setosiscutellatus* Cwfd., *Zatropis incertus* Ashm., and *Perisierola* sp. were reared from pink bollworms, for the most part from larvae feeding in the blooms. None of these species was very abundant. A disease of the larvae has been identified by G. F. White as a septicemia caused by a bacillus, possibly new. While prevalent under laboratory conditions the occurrence of this disease in the field has not been determined.

Field tests of cultural-control methods and development of special machinery for the clean-up of cotton fields were continued in cooperation with the Bureau of Agricultural Engineering. Early winter plowing and irrigation of a 50-acre field caused a heavy mortality of overwintering larvae but the area was not large enough to prevent the infiltration of moths from surrounding fields building up a heavy infestation. Need for a more efficient and cheaper method of cleaning up infested cotton fields has led to the designing and testing of an improved pusher type of stalk shaver which seems promising.

The survival from hibernating larvae under various conditions both at Presidio and Tlahualilo was greater in the spring of 1933 than for the past several years. This accounts for the present indications that the infestation in the Big Bend country will be about the same as last year despite the smaller number remaining in the fields last fall after the floods and clean-up of fields had destroyed a large part of the larvae.

The area infested with the pink bollworm has changed but little since last year. Shortly after the discovery of this insect in southern Florida in the

spring of 1932, the finding of light infestations in the northern part of the State caused considerable alarm. Thorough surveys by the Bureau of Plant Quarantine and State officials showed that the infestation was limited to several counties near the Georgia line and did not extend into the more important cotton areas of the adjoining States. Prompt and vigorous eradication measures were taken by the Bureau of Plant Quarantine and up to September 1933 no recurrence had been found. Surveys made by the Bureau of Plant Quarantine with the Bureau of Entomology cooperating revealed more wild cotton than was anticipated and a rather general infestation of the pink bollworm in the wild-cotton-growing areas on the mainland and adjoining keys from Miami southward and westward along the coastline as far north as Tampa. The Bureau of Plant Quarantine is making good progress in cleaning up the wild cotton in the areas of known pink-bollworm infestation in order to eliminate or greatly reduce the danger of natural spread or carriage by man to the commercial cotton-growing areas in the northern part of the State.

Eradication from the Salt River Valley of Arizona apparently has been successful, as no infestation was found in this area in 1932–33, while the known infestations have not increased in size in other parts of Arizona, New Mexico, and Texas. No new areas of infestation in the Rio Grande Valley have been reported as a result of the two heavy floods last fall which carried infested seed cotton from the Big Bend area southward.

INSECTS AFFECTING FORESTS, INCLUDING THE GYPSY MOTH AND OTHER MOTHS

The work in this division is under the direction of F. C. Craighead.

An important activity of the Division of Forest Insects is its cooperation in pest control with the several Government agencies administering timberlands, viz, the Forest Service, Park Service, Indian Service, and the Civilian Conservation Corps. Private owners were also helped to a less degree. For the most part, this cooperation consists in surveys of bark-beetle infestations, estimating the losses, making recommendations as to methods of control and furnishing estimates as to costs of such operations. In some of the projects it has been possible to assign a forest-insect specialist to train the personnel of these agencies and to advise on technical matters arising in the course of the work.

WESTERN BARK BEETLES

The most destructive forest insects, especially in the western forests, are bark beetles. Several of the more important of these have been under investigation for years, but during the past year new developments have given promise of real service in aiding in the control of these pests.

One of these developments has been the killing of from 25 to 92 percent of the overwintering brood of bark beetles in the pine region of eastern Oregon and Washington, northern California, and the northern Rocky Mountain forests. Mortality of these broods in the larval stage from freezing has been recorded only a few times in the past and never before has been noted over such a large area or to such a degree. The effects of this excessive and continued cold period of the winter of 1932–33, involving temperatures of from —20° to —50° F., indicated the importance of this phase of control, which from time to time must have had large influence in reducing the numbers of bark beetles and other forest pests. Fortunately the Bureau was able, during the cold period, to make studies of the relation of exposure, bark thickness, and air temperatures to beetle control. These studies were aided by laboratory investigations made some years ago at the California station, at which low temperatures fatal to pine beetles had been determined. The killing of overwintering broods has made it possible to abandon various control projects which had been planned and to discontinue others which were under way.

THE WESTERN PINE BEETLE

During the 1932 season the infestation of the western pine beetle declined somewhat in California but reached its peak in eastern Oregon and Washington. The low temperatures just discussed were particularly useful in reducing the overwintering broods of this bark beetle in Washington, Oregon, and northeastern California. In other parts of California it still exhibited

epidemic tendencies, the effects of the freeze being irregular and apparently altogether lacking in the central Sierra Nevada region. Some eight control projects directed against the western pine beetle, but including some other bark beetles, were carried out in California this year. These involved expenditures, by the forest agencies concerned, totaling $120,000.

MOUNTAIN PINE BEETLE

The mountain pine beetle, although still very injurious in much of its range in the northern Pacific and Rocky Mountain forests, suffered a high mortality in many of the forests from the excessive cold of last winter. This may perhaps make possible the reopening of several control projects formerly abandoned as hopeless.

Improvements have been made in control methods by means of which it is believed that many of the parasites and other beneficial insects which have hitherto been destroyed along with the bark beetles may be protected and saved. This should aid in maintaining the natural balance between such beneficial insects and bark beetles and lessen the likelihood of serious outbreaks of the latter.

An effort to control serious outbreaks of the mountain pine beetle has been under way over a period of years in several areas, and, as to some of these, substantial success has been reached during the past season. After many years of effort, complete control of this beetle in the pine forests of Crater Lake National Park has been achieved. Last year 20,311 infested trees were found and treated on an area of 30,000 acres. This spring only 6,163 infested trees were found on the same area and these were disposed of by workers of the Civilian Conservation Corps. A 2-day inspection following this work failed to disclose any infestation.

Four seasons of artificial control directed against an outbreak of the mountain pine beetle in the highly prized commercial white-pine stands of the Coeur d'Alene National Forest were completed during June 1933. This is the largest bark-beetle-control project ever undertaken, having been instituted in 1930 under an appropriation to the Forest Service of $150,000. During the past three seasons additional expenditures amounting to $120,000 have been made in conducting clean-up work. As a result of this expenditure the valuable white-pine stands of the Coeur d'Alene National Forest, totaling some 900,000,000 board feet, have been preserved from seemingly inevitable destruction.

A similar project which has been under way for the past 5 years on the Kootenai National Forest, involving an expenditure of $75,000, has also resulted in the preservation of valuable commercial timber stands. During the past season bark-beetle control projects against outbreaks of the mountain-pine beetle were also conducted in the Yellowstone, Teton, and Mount Rainier National Parks, and in the Wyoming, Cache, Medicine Bow, and Montezuma National Forests.

Infestations of the mountain pine beetle in sugar pine have been increasing for the past two seasons in the central Sierra Nevada region. Losses continue heavy except on those areas where direct control measures have been initiated. In some areas the 1932 losses were found to run as high as 1,000,000 board feet to the timbered section. The heavy precipitation which occurred in this region during the winter of 1931–32 did not contribute toward any general check of this insect.

EASTERN WORK

SOUTHERN PINE BEETLE

The southern pine beetle was active in the Coastal Plain from southern Pennsylvania to Georgia. In the northern portion of its range, from southern Pennsylvania to Virginia, it was more destructive than at any time during the last 40 years. One of the most serious infestations was in Fairfax County, Va., where 7,500,000 board feet of short-leaf pine timber and some 30,000 cords of pulpwood have been destroyed.

MEDICATING TREES

Investigative work has been continued with special reference to the development of the best technic for medicating trees by the injection method.

Promising results have been obtained in injecting insect-destroying poisons into trees infested by bark beetles and a simplified and more efficient method has been devised. This technic, which takes advantage of the natural forces causing the rise of sap in living trees, has also been used successfully in injecting preservatives into such trees. It is hoped that by this method trees which will later be felled and utilized will be more cheaply and effectively impregnated with the preservative.

Encouraging results have also been obtained from spraying the bark of infested trees with a substance that will penetrate and kill the borers. To date certain oils and orthodichlorobenzene have been found most effective.

LOCUST BORER

In the investigation of the locust borer, in Tennessee, Kentucky, Indiana, Illinois, Ohio, Michigan, Pennsylvania, and New York, special emphasis has been placed this year on soil studies inasmuch as tree vigor seems to be the dominant factor in lessening injury; hence character of soils may have a very important bearing on the problem. The important soil factors, as affecting the locust, appear to be compactness, organic matter, and drainage.

FOREIGN WORK

One entomologist with headquarters in Budapest, Hungary, has been engaged in securing and shipping to the Melrose Highlands, Mass., station parasites of the European pine-shoot moth, the larch case bearer, the satin moth, the elm leaf beetle, and the sawfly *Phyllotoma nemorata* Fall. that mines the leaves of the birch. All of these destructive insects have gained entrance into the United States from foreign countries, and efforts are being made to establish in this country as many as possible of the parasites that attack them abroad. In the case of the first three mentioned, this work is of comparatively recent inception, having been started in 1930 or later. It is therefore too early to judge the results or even to indicate what parasites have become established.

Information is being secured also regarding the distribution and natural enemies of the beech scale in Europe. Several predators have been noted feeding on this scale, but more information is desired regarding them before attempts are made to establish any of them in New England.

LIBERATION AND RECOVERIES OF PARASITES

Approximately 6,000 females of a tachinid fly (*Phorocera agilis* R. D.) and about half that number of males were liberated in two gypsy-moth infestations in Massachusetts. These flies issued from puparia received in 1932 from Europe, where this fly is an important enemy of the gypsy moth. No puparia were imported this year, since it was thought that the fly has been given sufficient opportunity to establish itself through liberations made during the past several years. That some establishment has been effected is indicated by its recovery during the past few years.

This season 1,650 females of *Rogas unicolor* Nees, a hymenopterous parasite of the satin moth, were received from Europe and put out in New England. The first introduction of this species concerned a few adults received in 1932. Apparently males seldom occur, but laboratory studies have shown that the species is able to reproduce parthenogenetically. The prospects for the establishment of this parasite are promising, since it requires no host other than the satin moth for its development.

The most important feature of the work with European-pine-shoot-moth parasites was the large number of two hymenopterons received from Austria and liberated in Massachusetts, Connecticut, New York, and Pennsylvania. A total of 121,450 adults of *Tetrastichus turionum* Hart. and 156,500 adults of *Copidosoma geniculatum* Dal. were put out, and collections of the host made later showed that the former species had passed through a generation in the field.

For the first time worth-while colonies of the parasites of the birch sawfly (*Phyllotoma nemorata* Fall.) were liberated this year, when a total of 1,300 females of *Chrysocharis* sp. and 500 females of *Phanomeris phyllotomae* Mues., obtained from material sent from Europe, were placed in the field in Maine.

Larch-case-bearer parasites were received from Austria and colonies of three species were put out. In the case of two species the numbers liberated were

small, but a total of 1,399 males and 1,639 females of the third species (*Chrysocharis laricinella* Ratz.) were liberated in Maine, New York, and Massachusetts. A generation of this parasite was reared at the station on small potted larch trees which were artificially infested by the case bearer by putting moths in cellophane bags that enclosed the trees. Later the parasites were allowed access to the case-bearer larvae by placing them in the same bags.

Two species of Hymenoptera parasitic on the eggs of the elm leaf beetle were received from Europe and approximately 1,300 adults were put out in California, Ohio, Virginia, the District of Columbia, and Massachusetts. A large percentage of these adults were *Tetrastichus xanthomelaenae* Rond., the remainder belonging to an undetermined species of the same genus.

The usual sample collections of eggs, larvae, and pupae of the gypsy moth, and of larvae of the satin moth and the brown-tail moth, have been made at designated points in New England to obtain information regarding the effectiveness of parasites that have been imported in the past and are now firmly established. The gypsy moth has been markedly more abundant this year than for the past few years, particularly in southeastern Massachusetts. Generally speaking, the percentage of parasitization of this pest is somewhat lower than last year, although, as usual, the sample collections indicate that the percentage of individuals killed by parasites differs in different sections of the infested area.

It is of interest that four of the enemies of the gypsy moth that were introduced from Europe into New England have been found in the gypsy-moth infestation discovered last year in the vicinity of Pittston, Pa. These four species are the predacious beetle *Calosoma sycophanta* L., two tachinid flies (*Sturmia scutellata* R. D. and *Compsilura concinnata* Meig.), and a hymenopteron (*Apanteles melanoscelus* Ratz.).

GYPSY-MOTH ATTRACTANTS

Experiments with attractants that may be used in traps to catch male gypsy moths have been continued. Such attractants are now prepared by clipping off the last three abdominal segments of live virgin female moths and preparing an extract from them in such solvents as xylene, benzene, or gasoline. Traps baited with these extracts have proved of practical value in locating isolated infestations of the moth. The attempt is being made to increase the efficiency of the attractant and trap by improved methods of obtaining, preparing, and storing the extracts and of utilizing them in the field. This year it has been found that the extract, instead of being stored as such, can be poured on to cotton, evaporated, and the cotton stored without any material loss of the attractant. Tests have also shown that the cotton or other absorbent containing the attractant after having been used in traps one season can be stored in a solvent and used again the next season with a loss of only about one half of its attracting power. At present the female moths used in securing the attractant are usually obtained from pupae collected in the field. Where the work is done on a large scale the limited period during which pupae can be collected is a hindrance. To lengthen the collecting period, large female larvae have been collected in numbers and placed in screened cages, where they are fed and allowed to pupate.

INSECTICIDES

The study of possibilities of control of the beech scale by application of various insecticides has been continued. Previous field experiments had indicated that spraying with miscible oils in the late fall was injurious to the growth but that early spring applications could be made safely. It has now been found that certain miscible oils injure beeches even when applied in the early spring. Spraying with concentrated lime-sulphur at the rate of 9 gallons to 91 gallons of water in the early spring gave 100-percent control of the scale and as yet no injury to the trees has been observed. In tests with nursery stock, a commercial mixture of ethylene oxide with carbon dioxide (proportions approximately 1 to 9) gave promising results when used against both the beech scale and hibernating satin-moth larvae, but further experiments must be conducted before definite conclusions can be drawn. In connection with the beech scale, additional scouting this spring has shown that the insect is widely distributed in southeastern Maine, involving many heavy infestations. This scale has also been found in towns in southwestern Maine and southeastern New

Hampshire. These infested areas were not located when previous scouting was done in 1931 and when the scale was found to occur in Liberty, Maine, in the North Shore section of northeastern Massachusetts, and in Boston, Mass., and neighboring towns and cities.

Of the materials tested for the control of the larch case bearer, concentrated lime-sulphur applied as a dormant spray gave the best results while only fair results were obtained with the various spray mixtures used in experiments for the control of the European pine shoot moth. Of the nonarsenical stomach poisons tested against gipsy-moth larvae malachite green gave the most promising results.

FOOD-PLANT PREFERENCE OF GYPSY-MOTH LARVAE

This year a number of tray experiments were conducted in which gipsy-moth larvae were given different types of foliage. In some trays the same type of foliage was used throughout the tests, while in others different types were substituted after the larvae had passed through part of their instars. Some of the trays gave interesting results which in a few cases were at variance with results obtained in tests of a similar nature conducted about 20 years ago. Such experiments may finally help to solve the problem of why the gypsy moth is seldom if ever noticeably abundant in certain areas while in others it is more or less a continuing pest.

INSECTS AFFECTING STORED PRODUCTS

The work on insects affecting stored products is conducted under the direction of E. A. Back.

PEA WEEVIL

The pea weevil is recognized as the chief drawback to the continued success of field-pea crops throughout the Palouse area of Washington and Idaho—hence the increased interest in, and appreciation of, work of this Bureau by growers and contractors. The establishment, also, of Federal grades for field peas, which place special emphasis on weevil damage, has still further stimulated the interest in control measures on the part of growers.

The possibility of attracting weevils returning from winter hibernation to early planted trap borders has been under experimental test during the last 2 years. That such trap rows are effective in concentrating and holding the weevils for a considerable period has been demonstrated during the last season. For example, it was possible to collect from trap rows, about the middle of June, nearly 1,500 weevils in 100 sweepings of the net as opposed to 8 weevils in a like number of sweepings alongside in the later-maturing vines of the field. Naturally this ratio changed as the field vines came into bloom. To give such border concentration a control phase it follows that it is necessary to develop some means of destroying the weevils while on these border plants. Experiments to determine such possibilities were started early in 1933, but no results of practical advantage to the grower have so far been obtained.

It becomes increasingly apparent to the growers that the burning of pea vines on the field after threshing offers a valuable means of weevil control, even though certain fertilizing values of the vines if plowed under are thereby lost. The data on the benefit from burning as to the crop of 1933 are not available, but studies made in the Willamette Valley in 1932 indicate that in fields left unburned the previous year infestation increased some 25 percent over that of burned fields. During the past season a community effort in such burning was undertaken at Barlow, Oreg., in the Willamette Valley. Sixteen small fields totaling some 200 acres were burned after harvest, all of the growers in the neighborhood uniting in this effort. Under normal conditions a good demonstration as to the value of this method should result with the crop of 1934.

Airplane dusting of pea fields with calcium arsenate during May 1932 and June 1933 has not demonstrated any great value. Nevertheless several prominent pea growers were so impressed with the possibility of such control that they have determined to continue tests another year.

The extremely low temperatures of the 1932–33 winter, previously referred to in connection with bark beetles in the northwestern forests, caused a very high mortality among hibernating pea weevils in the Palouse area, with the

result that the 1933 crop has been relatively free from damage. From studies conducted by the Bureau on winter shelters of cage type it developed that a temperature of —2° F. was fatal to all the weevils in such cages in this area, and also in the Willamette Valley in Oregon. Weevils in cages better protected by grass and snow survived in very small percentages at a temperature of —13° at Emmett, Idaho, at —23° at Ames, Iowa, and at —18° at Moscow, Idaho. Similar mortality was found in weevils hibernating in cracks in fence posts and high mortality of less extent was determined in weevils that had sought shelter beneath the bark of ponderosa pines. Similar studies made during the preceding, much milder winter revealed little killing effect on hibernating weevils.

Notable among the new facts determined in 1933 is that adult weevils can remain dormant in harvested peas over two crop years and then emerge without loss of vigor or fertility. A second important addition to our knowledge of the biology of the pea weevil is the fact that it may have a supplemental second generation in a season. It has long been well established that the pea weevil cannot continue to produce generation after generation in dried seeds in storage as in the case of the common bean weevils, but it was determined that weevils emerging from early harvested peas will lay eggs on late-developing peas if such are available, establishing the possibility of two generations annually. An explanation is here afforded of the occasional finding of eggs in abundance on the pods of peas grown late in the season in western Oregon and California for shipment in the green state. This ability to produce two generations a year may become of sufficient importance to require application of additional control measures.

BEAN WEEVILS

On June 30, 1933, the bean-weevil laboratory which has been located at Modesto, Calif., for the past 6 years was discontinued because the investigation was substantially complete except for extension and service features. While this work has been heartily supported by the trade organizations in the affected areas, and while practicable means of substantial prevention of infestation have been developed, it cannot be said that the bean growers, as a whole, have been thoroughly alive to their opportunity for concerted action. At the present time, the degree of infestation in the deliveries is small, yet the percentage of deliveries showing some infestation is so high on receipt at warehouse that fumigation is necessary to prevent the crop from going rapidly out of condition in storage.

DRIED-FRUIT INSECTS

The personnel of the dried-fruit-insect laboratory at Fresno, Calif., has given special attention to the problem of fig-insect control on ranches. The dried fruit beetle and its close relatives, usually important, have been much less abundant and the raisin moth (*Ephestia figulilella* Greg.) has assumed the major role. That the raisin moth is not likely to prove a serious competitor of the Indian meal moth in injuring dried fruits in storage is indicated by recent studies conducted in orchards and drying yards on the ranches, and in warehouses and at packing plants. Considerable fears of such injury in storage by the raisin moth have been aroused by the tremendous numbers of the larvae of this insect coming from fruits recently delivered from the ranches. Observations on these larvae indicated that they were merely leaving the fruit to seek suitable places for transforming to the moth stage, and that they failed to find in such dried fruits in storage a satisfactory place for the development of succeeding generations. The attacks of the raisin moth on fruits undergoing the drying process on ranches have become the primary factor in reducing the cash returns to the growers—the losses in 1932 having been estimated as about $216,000 due to lowered quality of figs alone. The raisin moth has been found to infest similarly other drying fruits or dried fruits stacked in orchards or vineyards.

In relation to the injury by the raisin moth discussed above, the Bureau has been concerned during the last two seasons in developing means of protection of drying fruit. The very promising experiments begun in 1932 in protecting drying fruit with tobacco shade cloth have been continued during 1933. These large-scale experiments in fig orchards have indicated that almost complete

protection from such injury may be obtained thus, the fruit thus protected showing little or no infestation as contrasted with infestation running as high as 60 percent in fruit handled under the prevailing drying-yard practices. The general summary of these experiments was considered of sufficient interest by the Dried Fruit Association of California to be published and distributed at the expense of that association. The full reports of the experimental work in 1933 are not yet available.

Some important discoveries in relation to the biology of this pest made during the year give promise of aiding future control efforts. One of these is that the larvae may hibernate in the soil beneath fig trees to continue their development the following season in the first crop of figs. This crop has been considered as unimportant and is commonly harrowed into the soil mulch, where, as now known, the larvae continue their development in the partially desiccated figs to attack later the main fig crop. Another important discovery of the year has been that the raisin moth develops in great numbers in the fruit of mulberry trees grown for shade about many vineyards and fig-packing yards. On an estimate based on sample counts of some 500 pounds of mulberries beneath one such tree, an infestation was shown of over 2,500,000 insects per ton. The mulberry fruit ripens during May and June in advance of the figs, and such infestation must be an important factor in building up large populations of the raisin moth to attack drying peaches, grapes, and figs later in the season.

FLOUR-MILL INSECTS

Insect conditions in the flour mills of the Southwest were worse in 1932 than in 1931, presumably because of the large quantities of grain held in storage. In the mill studies of this year special attention has been given to the degree of penetration of the fumigant to the various parts of cleaned and uncleaned milling equipment. One hundred and fifty-seven box cars which had been accepted by milling companies as being fit carriers for flour were examined for insects, fumigated, and the data tabulated. As might be expected, consistent kills of insects in box cars are not obtained because of the variation in construction and condition of the cars. The results of the examination and fumigation of box cars, as carriers of flour, for 1932 and 1933 are in process of being prepared for publication.

Of special interest during 1933 are the experiments to determine the value of introducing liquid hydrocyanic acid through copper piping directly to the interior of milling equipment, as compared with the present practice of spraying the liquid into the mill space proper. Instead of leaving the machines open so that the fumigant can penetrate them, as has been the practice for years, the newer idea is to introduce the liquid into the interior of the closed machine and permit the vapors to diffuse slowly to the outer spaces of the mill proper. It is believed now that this method of introducing the fumigant places the vapors in greatest concentration where the infestations are apt to be most severe. These experiments, while promising, offer insufficient basis to warrant definite recommendations.

Studies of the biology of the two common species of flour beetles (*Tribolium confusum* Duv. and *T. ferrugineum* Fab.) have been completed during the year. A preliminary paper was published in February 1933 and has been distributed. A technical bulletin giving more complete data has been prepared and is in process of publication. Probably no insects are so generally troublesome to the flour trade as these two species of beetles, yet until these investigations were started very little of the details of their biology was known. Of special interest to shippers and others is the fact that both of these beetles seem able to survive as adults for over 2 years. Adults of *Tribolium confusum* held at the usual room temperatures obtaining in a heated office building produced viable eggs for 432 days, the largest number of eggs laid by a *confusum* female being 976. As a rule the beetles lay only 2 or 3 eggs a day although as many as 13 eggs so laid have been counted. At about 80° F. eggs of both species hatched in from 5 to 7 days. These new facts are of practical importance to flour dealers charged with the protection of flour in storage or in settling litigation growing out of insect infestations developing during transit or storage.

Investigations of other flour beetles were started during 1933 and will continue for several years.

GRAIN INSECTS

Very little active research has been conducted during the past year with insects affecting stored grain. Where opportunity has been presented Bureau representatives have attempted to determine the effectiveness of various fumigants used on a commercial scale. Gratifying results have been obtained in fumigations with calcium cyanide, chloropicrin, the ethylene oxide-carbon dioxide mixture, the ethylene dichloride-carbon tetrachloride mixture, and less satisfactory results with propylene dichloride. Of particular interest are the claims made for electricity as a means of destroying insects in grain. While the name of the Federal Bureau of Entomology has been mentioned frequently in connection with such experiments during the past year, the Bureau has conducted no tests that warrant it to take, at this time, a position in favor of treatments of bulk wheat by electricity.

INSECTS AFFECTING CURED TOBACCO

The large-scale fumigation of tobacco storages of the closed type, in the Bright Tobacco Belt, reported upon last year have been continued during the fiscal year covered by this report. The fumigated warehouses have a total capacity of 7,092,099 cubic feet, and contained approximately 42,000,000 pounds of domestic flue-cured tobacco, valued at about $10,000,000. Five fumigations were conducted in these warehouses under the direction of the Bureau from June to December 1932, a dosage of 10 ounces of liquid cyanide per 1,000 cubic feet of space having been used in most instances. Since the cigarette-beetle infestation was negligible during the 1932 season because of the fumigations conducted during 1931, the main object of the 1932 experiments was to bring about a control of the tobacco moth (*Ephestia elutella* Hbn.). The five fumigations, conducted on June 1, June 28, August 3, September 8, and November 7, respectively, very satisfactorily controlled the tobacco moth. The average cost of these fumigations was 61.2 cents per 1,000 cubic feet of space, or about 48.7 cents per 1,000-pound hogshead of tobacco. Since each hogshead of tobacco is valued at about $200, this cost for control does not seem excessive. The cost for the fumigations is divided as follows: Liquid cyanide, 81 percent; materials for sealing storage, 4 percent; labor for sealing storage, 6.5 percent; service charge, commercial fumigator, 8.5 percent.

In cooperation with a tobacco concern at Danville, Va., a warehouse containing 484,537 cubic feet, housing 3,500,000 pounds of tobacco valued at $875,000, was fumigated on June 15 and September 28, 1932, with a dosage of 20 ounces of liquid cyanide per 1,000 cubic feet for a period of 96 hours. Good kills were obtained in test boxes of insects placed 6 inches beneath the staves of the hogsheads, and examinations revealed no living insects. Owing to the migration of beetles from warehouse to warehouse in the same storage area of Danville the fumigated area became infested and the September 28 fumigation was needed. Examinations made following this fumigation showed that few larvae of the cigarette beetle, lodged 6 to 8 inches in the tobacco beneath the staves, had escaped the action of the fumigant.

The migrating habit of the adult cigarette beetle, which urges it to fly from the dark storages to the light and to swarm outdoors around storages, is well known among tobacco men. A flight of unusual numbers occurred in Danville, Va., during the summer of 1933, when citizens of the south side of the city were much annoyed by beetles flying in through windows and penetrating to all parts of their houses.

Recognizing the migrating habit of the cigarette beetle as a fertile factor in vitiating the benefits of fumigation in congested areas, the Bureau, in cooperation with a Danville, Va., tobacco concern, has secured the thorough screening of a large tobacco storage which is being fumigated, to determine to what extent the screening can be depended upon to exclude cigarette beetles once those within the screened storage have been brought under control. This experiment, started in 1933, is still in progress.

Recognizing the research advantages to the Bureau of cooperation with various tobacco concerns conducting private fumigations, the Bureau representatives have endeavored to give assistance wherever possible. It is estimated that during the calendar years 1929–32 97,940,000 cubic feet of tobacco storage in the Bright Tobacco Belt were fumigated with hydrocyanic acid gas. The percentages of yearly increase in fumigated tobacco storage since 1929, the year before these investigations were started, are 145.3 percent for 1930, 85.3 percent for 1931, and 95.4 percent for 1932.

Of special interest to tobacco storages is the suction light trap developed during 1932 in cooperation with H. R. Hanmer, in charge of research of the American Tobacco Co. Mr. Hanmer's original trap, designed for using a combination of suction and light, has been improved upon until an effective trap has been developed, covering which a public-service patent in the names of H. R. Hanmer and W. D. Reed of this Bureau has been applied for through the Solicitor of the Department. From 50 to 85 traps were operated each week from October 1 to December 31, 1932, in the Winston-Salem area, during which period the traps caught an estimated total of 39,487,602 cigarette-beetle adults and 40,885 tobacco-moth adults. In a large open storage warehouse in Richmond, housing "Turkish" tobacco, the average catch per trap for 7 traps during the first week of their operation (August 12–19) was 87,452 cigarette-beetle adults and 348 tobacco moths. During this Richmond experiment, continued from August 12 to December 22, when all insect activity ended in the unheated storages, the 7 to 14 traps in operation captured an estimated 5,454,895 cigarette-beetle adults and 16,023 tobacco-moth adults.

While tobacco concerns have showed their enthusiasm for these suction light traps by constructing and putting into operation considerable numbers during the calendar year 1933, the Bureau experts have been attempting during the past year to determine just how practical a result follows the destruction of such large numbers of insects by means of the traps. The results are not available for this report although accumulating data indicate the practicability of the traps, particularly in the numerous open storages which are not suited to insect control by fumigation. A description and blueprints of the trap are available upon application.

Studies of the biology of the cigarette beetle and of the tobacco moth have been continued during the year and the new information is being made available in correspondence and prepared for publication. A preliminary study of the biology of the tobacco moth was published during the year as Circular No. 269 of the Department.

At the request of the Tobacco Association of the United States, W. D. Reed, in charge of the Richmond laboratory for study of cured-tobacco pests, was authorized to study insects affecting tobacco at points in Greece, Turkey, and Italy where American-owned tobacco is manipulated and stored previous to exportation to the United States. It is recognized that the long storage periods before importation into this country give the cigarette beetle and the tobacco moth ample opportunity to breed to destructive numbers. It is hoped that improved methods of control can be recommended that will be practical under the conditions existing in the storages visited and that in the end the conditions in our own storages will be improved materially as a result of the lessened infestations in imported tobacco following Mr. Reed's trip. Mr. Reed sailed for Athens from New York on July 14, 1933.

HOUSEHOLD INSECTS

During the calendar year 1933 the market has been flooded with cardboard containers in the form of chestlike boxes and closets. These containers usually have been impregnated with oil of cedar or some other oil possessing some insecticidal value when used under certain conditions, or with cedar chips, paradichlorobenzene, or naphthalene. Tests to determine the value of such containers impregnated with cedar oil or cedar chips indicate that they are worthless as protectors against clothes-moth infestation. When the tests were made the cedarized containers were set inside a closet constructed of wall board and containing 130 cubic feet of space. Adult clothes moths were introduced inside the large closet on August 8, 11, and 16, 1933. On September 5, 1933, the cedarized containers were removed from the large closet and opened. Large numbers of adult clothes moths were found inside them and the pieces of woolen cloth fastened to the interior of the containers were heavily infested with clothes-moth larvae which had developed from eggs laid on the cloths by the female moths introduced into the large closet. The larvae had grown well and had caused serious damage to the cloth. These experiments indicate that the clothes-moth adults can readily pass through the cracks about the lids of cardboard containers and that the containers are not sufficiently tight or otherwise conditioned to give protection to clothing against moth injury.

Tests to determine the value of vetivert roots indicate that these roots, although advertised to be of value in protecting clothing stored with them, are

of no value as a protection against clothes moths. Vetivert roots in a box were moistened with water according to directions and placed in a large closet. An uninfested piece of woolen cloth was buried among the roots and 100 adult clothes moths then liberated in the closet. A few days later large numbers of clothes-moth eggs were found deposited on the cloth and a later examination proved that the eggs had hatched and that the larvae were growing happily although surrounded by vetivert roots! It would appear from other tests that if adult moths are given an opportunity to oviposit on cloths perfumed with vetivert extract, or on untreated cloths, they prefer the unperfumed cloths, although if no other cloth is available they will deposit their eggs on the perfumed cloth. Experiments are still in progress.

A study of the food requirements of clothes moths and carpet beetles has been undertaken during the year. It will continue for several years and will include a study of the effect of various dyes upon moth mortality.

The carpet beetle *Anthrenus vorax* Casey continues to increase in the city of Washington. This species is responsible for considerable activity as evidenced by fumigations conducted by local storage and insect-exterminating firms.

The dissemination of information concerning the more common insects of the household, such as clothes moths, carpet beetles, bedbugs, cockroaches, silverfish, furniture pests, and psocids, requires much time on the part of those charged with the work of this office.

INSECTS AFFECTING WOOD

Commercial operators are still exaggerating the extent and seriousness of termite damage to buildings, and the Bureau of Entomology has been making every effort to present the true facts to the public. Leaflet No. 31 of the Bureau has been revised, and reissued as Leaflet No. 101, to make the recommendations for remedying damage to buildings already constructed and for preventing damage to new structures more simple and understandable.

In cooperation with a prominent electrical company large-scale tests of some 40 chemicals, for the control of termites infesting telephone poles, were started during 1933 on Long Island, N.Y. These experiments will be of long duration and have for their object the determination of the value of the chemicals as poisons when applied to the soil about some 400 poles. It is hoped that the data obtained in connection with these tests involving telephone poles will be useful in determining whether or not soil poisons have a practical place in the protection of the foundations of buildings from termite attack.

The experimental work against termites, reported upon last year as being conducted on Barro Colorado Island, Canal Zone, Panama, is being continued and augmented as additional treated woods are included in the termite-resistance tests. At present the tests include woods, variously treated, in the form of stakes, poles, towers, bridges, and even small cottages. These long-time-service tests are being conducted in cooperation with the Forest Products Laboratory of the Forest Service of this Department and the American Wood Preservers' Association. Since termites have been destructive to untreated composition wall and insulating boards, poisoned samples of these wood-pulp and fiber boards have been included in the Panama experiments.

At the request of the War Department an examination, in cooperation with the Forest Service, was made during May 1933 of the arsenals at Rock Island, Ill., New Cumberland, Pa., and Springfield, Mass. A confidential report was submitted on the condition of the buildings and wooden military supplies, and recommendations for correcting insect damage and decay to the buildings and wooden articles stored therein were made. Such examinations have been made once in every 2 or 3 years.

Negotiations are under way to have all Government departments adopt uniform specifications for remedying termite damage to the woodwork of buildings. It is hoped that this will prevent the use of the name of the United States Government in advertising by firms which have treated a few Government buildings and in consequence claim to have received all Government contracts on a noncompetitive basis.

The fourth progress report on the international termite-exposure tests was presented before the annual meeting of the American Wood Preservers' Association held at Chicago in January 1933. Identical treatments that are being tested in Australia, Hawaii, Panama, and South Africa are yielding somewhat different results under these varied environments.

INSECTS AFFECTING MAN AND ANIMALS

Investigations of insects affecting man and animals have been continued under the direction of F. C. Bishopp.

Insects which attack man and animals naturally have wide public interest in both town and country. Work in this field has as its main object the determination of better control methods for such insect pests and in a sense has an important humanitarian aspect in that it may result in increased comfort and happiness to our entire population by lessening the annoyance occasioned by house and stable flies, mosquitoes, and other more directly parasitic types. Similarly, the control of the insect pests and parasitic enemies of domestic animals presents both the feature of abatement of torture from biting insects and also protection against external and internal parasites.

In addition to the important lines of research carried on in this field, an increased effort has been made, in response to requests from individuals or communities, to give information directly applicable to the subject presented rather than, or supplemental to, distribution of publications.

Similarly, an effort has been made through the work of extension entomologists of the Bureau and also by personal contacts with State and local authorities and individuals to secure a coordination of effort and uniformity of procedure in control work. Local, State, and Federal agencies have been urged and encouraged to use available funds for giving employment to the carrying out of needed insect-control projects. In a number of instances assistance has been given to the planning and initiation of such projects.

Of distinct public-service nature, also, has been the investigation by this division of the use of maggots in surgery. This work has made it possible to furnish specific information to laboratories and hospitals on the best methods of rearing and handling sterile maggots.

SCREW WORM AND OTHER BLOWFLIES

These pests are of the greatest economic importance every year in the southwestern livestock-range country, but recently two outbreaks have occurred at considerable distances from this general region, causing serious losses to all types of livestock. The first was in the fall of 1932 in Mississippi and Louisiana and the second in Georgia and Florida, and to a lesser extent in Alabama and Mississippi, during the summer of 1933. Stockmen and others in these areas were unfamiliar with this pest and of the methods of combating it and became greatly alarmed. Drawing on its wide experience with this problem in Texas and other western States, this Bureau, in cooperation with the Bureau of Animal Industry, made, through personal contacts and otherwise, every effort to familiarize county agents, veterinarians, and stock owners with the methods of control, and by this means losses were materially reduced.

The large-scale trapping experiments in Menard County, Tex., described in the last annual report, have been continued. A larger area of range and a few more traps have been used. This method of control of the screw worm continues to show great promise when, at the same time, a rigid system of burning all carcasses on the range is practiced.

Considerable improvement has been made in the manner of baiting the traps in use. The larvicidal values of certain chemical compounds when used in the baits, and their effect on the attraction of the baits for blowflies, have been investigated. Other chemical compounds, which apparently greatly enhance the attracting properties of meat baits, also have been investigated. The results indicate that the dipyridyl oils give very good results as larvicides when used in connection with meat baits. The toxicity of the dipyridyl oils, when used in certain dilutions in meat baits, is slightly less than that of nicotine sulphate, but the cheapness and oviposition-inhibiting characteristics of these oils, as compared with nicotine sulphate, are important and highly desirable factors in their favor.

The data obtained from several tests indicate that the addition of limited quantities of either potassium sulphide or sodium sulphide to meat baits greatly enhances the attraction of the bait. Of the two, potassium sulphide is slightly more attractive than sodium sulphide.

During the past 4 years a study has been made of the predisposing causes of screw-worm attack in relation to eight classes of range animals, viz. sheep, lambs, goats, kids, cattle, calves, horses, and mules. Among sheep 24 such predisposing causes have been established. Arranged in the order of their impor-

tance they are as follows: Needle-grass injuries, fighting, horn-fly attack, shear cuts, accidental injuries, pricklypear, birth, sore mouth, udder injuries, boils, dehorning, beggar lice (seeds), broken horns, rock-bruised feet, brush scratches, wire cuts, old sores, dog bites, hooking injuries by cattle, marking, genitalia injuries, castrating, louse attack, and tick attack. In lambs the number of predisposing causes is 19, in goats 26, in kids 17, in cattle 24, in calves 22, and in horses and mules 14. The investigation has shown that the factors or conditions responsible for several of the common predisposing causes of screw-worm attack in all classes of animals are due to certain common range practices, and can be reduced or eliminated by modifications of the methods in question.

A survey to determine the distribution and seasonal abundance of parasites and predators attacking the screw worm and other blowflies has been continued and extended to new areas. This work has resulted in the determination of new and important parasitic enemies of blowflies and given much additional information of value on the activities of other parasites. Studies have been made also of the many beetles which both in the adult and larval stages feed upon blowfly larvae developing in animal carcasses and thus very greatly aid in the control of this pest. The purpose of this survey is to more accurately determine the control value of these natural agencies with the possibility of increasing their effectiveness.

EYE GNATS

The eye-gnat problem continues to be of decided importance in the Coachella and other valleys in southeastern California and in the Southern States, particularly in Texas and Florida.

Experiments with traps and baits have been continued at Coachella, Calif. That adequate continuous trapping exerts a real control upon the pest is indicated by the effects of the discontinuance of trapping for a short time in the vicinity of the high school in Coachella. At this location the traps had been maintained in working condition for several months. For the purpose of cleaning them they were taken out of operation for 1 week in the first half of April 1932. The abundance of gnats about the school increased sharply and it was not until several weeks after the traps had been again placed in operation that the former status was restored.

Cultural tests indicate that eye gnats breed only in light, loose, freshly worked and moist soils, usually those cropped to truck and fruits, and that few gnats breed in soils with heavy cover crops or with manures turned under in the months of January, February, July, and August. These facts may prove to be a valuable basis of control under some conditions of farm or ranch management. The determination of the fact that eye gnats breed in garbage and excreta makes the prompt and adequate disposal of these very important. Some attention has been given to this subject.

Some preliminary work has been done along the line of applying poisons or repellents to soiling crops as they are turned under. The results show some promise and the enlargement of these tests is contemplated. The possibility of testing insecticides nonpoisonous to higher forms of animal life for control of the gnats in irrigation waters is also under consideration.

MOSQUITOES

During the preceding fiscal year and the first part of this year a cooperative agreement with the International Health Division of the Rockefeller Foundation was in effect under which W. V. King of the Bureau staff made an intensive study of the problem of malaria-carrying mosquitoes in the Philippine Islands. This work has been of supreme importance to the members of the Army units stationed in the islands and to local authorities in pointing the way to more effective malaria control by determination of the species which actually transmit malaria and the concentration of suppressive measures upon them.

In cooperation with the city authorities of Portland and of Multnomah County, Oreg., much antimosquito work was done in the vicinity of Portland, where the flood-water mosquitoes are a most serious pest to people and livestock. In these extensive clearing and draining operations the unemployed were largely used under relief funds.

At the Portland laboratory studies of the life histories, habits, and means of controlling the mosquitoes (*Aedes aldrichi* Dyar and Knab and *A. vexans* Meig.) which breed abundantly in willow flats and cottonwood ridges along the Columbia River have been continued.

A special study of mosquito control has been made in the vicinity of Klamath Falls, Oreg. In that section myriads of mosquitoes are produced in the irrigated hay and grain fields, many of which are several thousand acres in extent. Preliminary recommendations have been submitted for reducing the mosquito pest. These were based upon the manipulation of irrigation water. The report, which was mimeographed by the Department, has been widely distributed in southeastern Oregon by the county agricultural agents.

Following a survey of the mosquito problem at Fort Madison, Wash., a control program was laid out and is being actively prosecuted by local authorities. Additional survey work has been done and recommendations made for mosquito control at Hood River and Tillamook, Oreg., and Ocean Beach, Wash. Considerable work has been done on various oils, arsenicals, and other poisons, including a study of their possible application in mosquito control. These investigations include a rather thorough study of the adaptability of the several oils available in this district. Tests were also made of the effect of various organic oils, acids, and bases, as well as of certain solids, on the spread and toxicity of the oils. It was found that several materials derived from plant products, such as cedar oil, castor oil, powdered rosin, turpentine, pine oil, and coconut oil, increased the spread of the oils, but that such materials as paradichlorobenzene, naphthalene, acetone, caustic soda solution, soap, aniline oil, sodium benzoate, etc., gave no increase and in some instances actually caused a decrease in the spread of the oil film.

Some data have been obtained on the flight range, dispersion, and longevity of *Aedes aldrichi* and *A. vexans*. This has been done by confining a large group of adults and spraying them with methylene blue or eosin. Over a considerable period stained specimens were captured which had flown from 4 to 5 miles and crossed the Columbia River within 10 days from staining. Adults 104 days old have likewise been recaptured.

A very general survey of the States of Washington and Oregon has been made to determine the breeding areas of malaria mosquitoes. This survey was rather intensively carried out in Lane, Linn, and Benton Counties, Oreg. The information thus gained has been assembled for publication with an account of the history of malaria and its present status in these States.

In October 1930 a small number of mosquito-killing fish, *Gambusia* sp., were received from California. These were divided and placed in three or four situations. All were lost with the exception of one lot of 35, which were placed in a small pond on Hayden Island near Portland. These increased to great numbers during 1931 and 1932, and stocks were placed in many localities. In June 1932 Hayden Island was flooded, and predacious fish were washed into the *Gambusia* pond. From that time the numbers of *Gambusia* began to diminish in this pond until at present none remain. These minnows had withstood one very severe winter but were evidently unable to withstand the attacks of small-mouth bass and crappies.

Working from the Orlando, Fla., laboratory as a base, the mosquito survey of Florida, with special reference to malaria-carrying species, has been prosecuted vigorously. In many areas the local authorities have been advised concerning control measures. Activity along this line has been greatly increased since funds allotted by the National Relief Administration have become available for the employment of labor for mosquito-control projects.

The mosquito survey of the Delaware-Maryland-Virginia Peninsula and the west side of Chesapeake Bay, in cooperation with the experiment stations of these States, has been continued. About 30 species of mosquitoes were encountered in this survey. One of these, *Anopheles atropos* Dyar and Knab, had not been previously reported north of the Gulf States.

During the year a three-reel motion-picture film depicting the main features of the biology and control of mosquitoes was completed. This film has aided greatly in the inauguration of mosquito-control projects. The members of the scientific force assigned to mosquito work cooperated with the Office of Motion Pictures in producing the film.

SAND FLIES

During the spring and summer of 1933 much complaint of annoyance from sand flies (*Culicoides* spp.) came to the Department from wooded areas of the Central and Eastern States. Investigation disclosed the fact that certain species of these pests breed in large numbers in rot holes of trees. On account of the close proximity, in many cases, of such tree holes to residences, it appears

that this source of breeding is responsible for much of the sand-fly annoyance in various parts of the country. Experimental tests indicate that such breeding may be eliminated by treating the tree holes once a year with creosote, or creosoted pine sap. Good tree surgery would of course be better still.

The salt-marsh sand flies continue to cause much concern along the entire Atlantic and Gulf coasts. At Fort Pierce, Fla., a diking experiment is giving promise for control of the two most important species of sand flies in the mangrove marshes. From 6 weeks to 2 months after the inundation with river water, small numbers of sand-fly larvae were found along the edge of the water of the diked area. After that time larvae could not be found in such locations. After a period of more than 4 months the water level was allowed to drop about 2 feet. Collections of soil samples from the new edge of the water failed to reveal any larvae, although soil samples from ditches and elsewhere furnished numbers of them.

The finding of concentrations of sand-fly larvae in ditches during the past 2 years appears to indicate that marsh ditches should be used for concentrating such larvae, that ditches in the higher marshes should be extended to flowing streams, and that creosoted pine sap should be used for destruction of larvae in ditch soil.

BUFFALO GNATS

For the past several years an annual outbreak of buffalo gnats in the Delta region of Mississippi and neighboring States has occurred during the early spring months. Death of livestock, particularly mules, from their attack has been frequently reported. To provide reliable information concerning effective remedies and control, investigations have been carried on to this end with the limited funds available. Only a beginning has been possible, but progress has been made on the biology and habits of the pest as a prerequisite to adequate control.

Tests made with repellents for protecting animals from gnat attacks showed a 5-percent pine-tar-oil emulsion to be of value. When gnats were abundant and persistent in their attacks, from 2 to 5 applications of this material were necessary each day to protect the animals. This emulsion is, however, easy to make and apply, can be either sprayed or mopped on the animal, is cheap, and no injury to the animal results from its use as is the case following a heavy coating of tar and grease, the repellent most commonly used in the region.

CATTLE GRUBS

The tests of the efficiency of the ordinary fly sprays in control of cattle grubs have been continued. The results to date indicate that such spraying has no practical value in the control of cattle grubs.

Various insecticides for killing the grubs in the backs of cattle by hand application have been tested. The comparatively new insecticide rotenone, in combination with benzol, was found to be highly efficient for this purpose. One half gram of rotenone was dissolved in 100 cc of benzol and approximately 1 cc of the mixture injected into the opening of each cyst. This method of treatment is relatively fast as compared with any other treatment applied to grubs individually.

Studies concerning the types of soil which are unsuitable to the further development of cattle grubs after they drop from the animal have been continued.

A careful study and recheck of certain points in the life history of cattle grubs was made which demonstrated that there are only three stages in the larval life of the insect, instead of five as formerly believed. The third stage is more vulnerable to insecticidal treatment than the second.

HORSE BOTS

Biological studies of horse bots have been continued. The finding by a foreign entomologist that the first stage of the common bot spends some time burrowing in the tongue of the horse before going to the stomach has been confirmed. The period spent in the tongue has been determined as approximately 1 month. This has an important bearing on the control of bots by treatment of the horse's stomach with a fumigant. To avoid reinfestation of the stomach from the tongue, all eggs on the hair of the animal should be destroyed 30 days before the stomach treatment is given, unless such treat-

ment is delayed until such time in the winter as will make certain that all eggs have been dead at least 30 days because of cold weather. It was determined that the date of last occurrence of larvae in the tongues of horses at Ames, Iowa, in 1933 was about the middle of January. This indicates that in that section ovicidal applications may be omitted in bot-control campaigns in cases where the internal medication is applied after the middle of December.

THE USE OF BLOWFLY MAGGOTS IN SURGERY

Surgeons continue to report splendid results from the use of maggots in the postoperative treatment of osteomyelitis and other infected wounds. A number of different phases of maggot production and utilization in surgery have been under investigation in cooperation with several hospitals where this treatment is employed. Special attention has been given to ways of reducing the cost of maggot production. A simplified technic has been developed which makes it possible greatly to speed up the sterilization and handling of the eggs. This is a definite step in the direction of making the maggot treatment more generally available to those suffering with osteomyelitis and other diseases. The high cost has been one of the chief barriers to more wide-spread use of this treatment.

In studying the means by which maggots bring about the rapid healing effects in the wound, it has been found that the principal factor involved is probably the extensive removal by the maggots of the dead and diseased tissue from the wound, and the destruction by them of the disease-causing bacteria.

Several articles bearing upon the results of this investigation have been published during the year, or are now in press.

RAT MITES AND TYPHUS FEVER

During the year a considerable outbreak of typhus fever occurred in Crystal City, Tex., and neighboring towns. An examination by a member of the field-station staff located at Uvalde, Tex., revealed the fact that the area in that vicinity was heavily infested with rat mites. The scourge of rats, and to some extent the mites, extended as far north as Uvalde and Sabinal, Tex., but no cases of fever occurred in these towns. This situation was taken over by the Bureau of Biological Survey and health officials and the rats were brought under control, which resulted in the control of the mites.

TICKS

The occurrence in many States throughout the country of the tick-borne disease of man known as Rocky Mountain spotted fever has given impetus to investigations of ticks, especially the American dog tick (*Dermacentor variabilis* Say) and other species which attack man. In cooperation with entomologists throughout the country and field workers in the Bureau of Biological Survey and the Forest Service much information on the distribution, hosts, and seasonal abundance of ticks has been obtained. In the vicinity of Washington, D.C., where many cases of this disease with a relatively high mortality have occurred, the tick vector has received special study. It has been found that the small rodents, particularly field mice, white-footed mice, and pine mice, serve as hosts for many of the larvae and nymphs. To a slight extent these immature stages engorge with blood upon squirrels. Rabbits are of less importance, and fortunately birds do not appear to serve as hosts at all. Where they occur, coyotes, foxes, opossums, raccoons, skunks, and others of the larger wild animals have been found to harbor the adult ticks. However, dogs play a much more important part in the engorgement of the adult ticks than any other host. Horses, cattle, and goats are of secondary importance in this respect. The close association of dogs with man makes them of paramount importance in connection with the disease. The application of ground derris powder or the hand picking of the ticks from dogs is being recommended. The use of the powder at weekly intervals gives satisfactory control, but hand picking has to be carried out at intervals of 4 days to prevent dropping of engorged ticks. The occurrence of the mice which serve as hosts, in close proximity to habitations and to roads and other places frequented by man, makes their destruction a matter of importance. Methods of controlling them have received consideration in cooperation with the Bureau of Biological Survey. The importance of preventing tick attachment to man by frequent exami-

nations of the body, by wearing special clothing, and by using repellents, has been emphasized to the public.

The brown dog tick (*Rhipicephalus sanguineus* Latr.), which is a severe pest of dogs in Texas and Florida, has become established in many northern localities through introduction on dogs from the South. These infestations in the North have been found to persist through the winters in heated houses. This tick is a very annoying household pest. The use of derris and derris derivatives on the dogs and in their sleeping places combined with insecticidal sprays on the walls of the infested rooms has given good satisfaction.

In the cattle-tick-eradication work in Florida the Bureau of Animal Industry has found that in certain areas the tick does not yield to the usual program of dipping or vacating of pastures. This was thought to be due to the extensive occurrence there of the tropical variety of the cattle tick, *Boophilus annulatus australis* Fuller, and the abundance of certain wild animals, particularly deer, which serve as hosts. The situation called for a review of the hosts, life history, and longevity of this variety of the cattle tick under Florida conditions, and such a study was begun at the request of and in cooperation with the Tick Eradication Division of the Bureau of Animal Industry. Deer were found to harbor considerable numbers of this tick but no other hosts have been found among the wild animals and birds thus far examined.

DEVELOPMENT OF FLY-SPRAYING MACHINES

The object of this study, reported here for the first time, but which has been pursued intermittently for the past several years, was to develop adequate machines for applying sprays to kill or repel flies which infest dairy cattle. At present there are no satisfactory machines on the market with which dairy cattle can be sprayed successfully. Their inefficiency lies in the fact that they either spray too large a volume of liquid, which is costly and also burns the cattle, or they spray a fine mist, which is diluted with such a quantity of air that it is not effective. The air blast also has a tendency to frighten the flies away before enough of the spray material has been applied to them. Another disadvantage of machines now on the market is their form of spray distribution, which does not have the correct break-up, throw, spread, and regularity.

During the past year various changes have been effected in the details of machines made previously. Tests have been carried out to determine the performance of various combinations of spray disks, basal disks, and pressures when used on the hand sprayer and the portable sprayer. From data thus secured the correct combination can be made for certain results desired, such as throw, spread, and rate of flow.

A high-pressure hand sprayer has been constructed which is a modified form of one made in 1931. It is smaller and easier to handle, but has a relatively higher pump pressure. A portable high-pressure sprayer has likewise been completed which is very promising. It embodies such desirable features as high pressure, long range, and wide distribution, a fine break-up and even spread. It is light and portable and may be operated by one man.

BEE CULTURE

The Division of Bee Culture is under the direction of James I. Hambleton with headquarters at Somerset, Md., and has three field laboratories—the intermountain laboratory, maintained in cooperation with the University of Wyoming, Laramie, Wyo.; the southern laboratory, maintained in cooperation with the University of Louisiana, Baton Rouge, La.; and the Pacific coast laboratory, maintained in cooperation with the University of California, Davis, Calif.

The work of this division covers all phases of apiary management and honey and wax production, and also the use of bees as aids to crop production in their role as cross-pollenizers of many plants.

DISEASES OF BEES

Laboratory investigations indicate that the causative organisms of European foulbrood and parafoulbrood, diseases of the brood of bees, are closely related, morphologically unstable, and difficult to differentiate in the vegetative stages. For many years "*Bacillus pluton*" has been considered the causative organism in the former disease and *B. alvei* a secondary invader. It is now apparent,

however, that *B. alvei* is the causative organism in European foulbrood and that the so-called "*B. pluton*" is nothing more than a mutant or variant of the parent organism. The verification of this fact lends considerable hope to the possibility of untangling factors, of which little is known, concerned in the spread of this disease.

Bacillus para-alvei, the causative organism in parafoulbrood, apparently has a life history similar to that of *B. alvei* in that under special cultural conditions the rod and spore stages produce mutants differing greatly in morphological and cultural characteristics from the parent stage. No new outbreaks of this disease, first discovered 3 years ago, have been reported. Apparently infection is still confined to Florida, Georgia, North Carolina, and South Carolina.

Since 1931 a total of 200 samples of commercial honeys have been examined for the presence of spores of *Bacillus larvae*, the cause of American foulbrood. Special laboratory technic has shown the presence of spores in 16, or 8 percent, of the samples. As a further check and in order to determine whether any of the 16 samples contained enough spores to produce disease, the samples were fed to isolated healthy colonies, the result being that only one colony contracted the disease. It may be assumed from these results that commercial honey plays a minor part in the spread of the disease, and that under present conditions of control and of the continued spread of American foulbrood certification of honey as to its freedom from contact with American foulbrood, as required by certain States, is not justified.

ECONOMIC STUDIES

One of the most comprehensive economic surveys ever made of beekeeping has just been concluded on the Pacific coast. This work was done cooperatively with the University of California; and although the data refer largely to California, certain economic aspects of the beekeeping industry of the entire United States have been included.

An outcome of this study in relation to honey marketing in California indicates that the market for honey can be greatly improved by the adoption of grades and standard containers, through cooperation of producers.

A study of honey production in Oregon has shown that when yield was below 30 pounds per colony the cost of production (1931) was 13.3 cents per pound. This cost gradually decreased, reaching 4.5 cents per pound with a production of 90 pounds per colony or over. Based on the records of 85 cooperators whose apiaries yielded surplus honey ranging from 22 pounds to 115 pounds per colony, the average cost of production (1931) was 6.4 cents per pound.

TECHNICAL STUDIES

Beginning with 1932 the percentage of successfully inseminated queens has been higher than in previous years. Out of 135 queens, 65 laid worker eggs, and of these 20 gave evidence of being fully inseminated. The results so far in 1933 have been even more satisfactory than in 1932.

Queen breeders often complain of heavy losses of queen cells. In the spring of 1933 a similar difficulty was encountered in the breeding yard at Somerset, Md., the cause being attributed to a severe attack of sacbrood, a virus disease of the brood. From 1,730 larvae transferred in 1933, 242 queens were produced, whereas in 1932 from 2,545 larvae 652 queens were raised. During 1932 three successive generations of certain strains were reared, and the same is true of 1933. Three different strains were successfully wintered over and have already been carried through three generations this season. These strains are being bred to establish pure lines, and careful biometric measurements are being made and kept up to date so that the results of each mating are known soon enough to afford an index of what is being accomplished. As an aid to this work a careful study has also been made of the results of natural queen mating in flight in the open.

Biometrical measurements have been made of the progeny of various queens in a study of the variation which occurs under identical conditions. It has also been possible to study the seasonal variation in the progeny of a single queen.

Premature supersedure or "mortality" of queens is a problem that has given queen breeders and purchasers of package bees and queens a great deal of concern. Preliminary work has been started in an effort to learn

the causes for early or abnormal supersedure and if possible to find a remedy. As an illustration of the high mortality that often occurs, 30 queens were shipped to the University of Wisconsin and introduced. Seven died in the cages during introduction, five were not accepted after introduction, and one queen was immediately superseded. This is an unusually high mortality, but illustrates what may happen in certain seasons under certain conditions.

It was found desirable to make a study of the weight per gallon of the various honeys produced in the United States, since it has been found that 12 pounds per gallon, the standard heretofore considered as correct, was too high. The result is that recommendations have been made for the adoption of 11 pounds 12 ounces as the minimum weight per gallon for honey under the United States grades. A number of methods have been worked out by which the weight per gallon of honey may be determined with fair accuracy and without expensive equipment.

A series of honeys from various floral sources was heated (approximately 1 hour at 140° F.) long enough to melt all the crystals, and cooled quickly. These were then divided into groups and subjected to varying temperature changes. The following honeys showed no indication of crystallization even though a sample of each has been kept in each of the four temperature compartments: Buckwheat, tuliptree, sourwood, tupelo, buckeye, fireweed, gallberry, and white clover.

COLONY-BEHAVIOR STUDIES

Detailed studies of changes in colony populations, brood rearing, honey production, honey consumption, pollen gathering, winter death rate, etc., are being made on isolated colonies. Using 12 colonies a correlation coefficient of 0.9219 ± 0.0149 was found between population and production. These colonies produced an average of 120 pounds of honey, the strongest producing 180 pounds. With colony populations of from 15,000 to 45,000 the production factor per thousand bees gradually increased with an increase in population, at 15,000 being 1.33 per thousand while at 45,000 it was 2.3 per thousand.

Bees emerging and working during the active season varied in length of life, on an average, from 22 to 48 days, the majority having an average life of about 5 weeks. Marked bees which emerged between August 23 and October 1 remained in the colonies in appreciable numbers until the end of June 1933, a period of 8 or 9 months. The average mortality during the winter was approximately 2.4 percent per month. Bees making up the winter cluster did not die numerically according to their age, nor was there any systematic distribution of bees according to age in the different parts of the winter cluster. This indicates a lack of division of labor among bees of different ages in the maintenance of the winter cluster. Many beekeepers in the Intermountain region attribute winter losses to the inability of bees to utilize granulated stores. Three experimental colonies having only solidly granulated honey wintered normally, indicating the probability that granulated honey in itself is seldom responsible for winter losses. Brood rearing during the winter has generally been considered abnormal and detrimental to successful wintering. With this in mind a series of colonies were provided with sugar or honey alone and others with honey and varying quantities of pollen. This experiment indicated a very much greater survival of bees receiving pollen than of those wintered on sugar alone, the greatest survival going with the largest amount of pollen. These tests strikingly indicate that brood rearing during the winter and early spring can be of great value and that a reserve of pollen for this somewhat out-of-season brood rearing may be highly desirable.

A final test was made of the effect of flight range upon honey production. An apiary of 30 colonies was so located as to be entirely surrounded by at least 1 mile of sweetclover, while another 30-colony apiary was located in the Bad Lands 1½ miles from any sweetclover. The inner apiary made an average net increase of 261 pounds per colony as against an average of 207 pounds per colony for the outer apiary. While these results do not check with similar experiments in which a smaller number of colonies have been used, they indicate that a good crop of honey can be obtained even though the bees may be located some distance from the source of nectar.

IDENTIFICATION AND CLASSIFICATION OF INSECTS

Investigations on the taxonomy of insects in the Division of Insect Identification and Classification have continued under the direction of Harold Morrison.

As heretofore, the greater portion of the time of the specialists of this unit has been used in making identifications of specimens submitted by other offices of the Bureau and Department, State experiment stations, etc.—a service essential to all phases of entomological work. Many of the specimens received for identification were submitted by the Bureau of Plant Quarantine. There has been a definite increase in the amount of material submitted for determination. The numbers of identifications for the year total 27,416, an increase over the previous year of approximately 6.5 percent.

In spite of the demand for identifications, some original scientific work in insect classification has been completed and offered for publication through appropriate scientific and technical channels within and outside of the Department. Three significant contributions dealing with economic groups are to be published as technical bulletins. One of these is a revision of a group of leaf hoppers, another deals with the hymenopterous parasites of the hessian fly, and the third with the biology and classification of fruit flies native to Florida.

The investigations required in making identifications develop important facts on the occurrence and distribution of insects. Studies during the year showed that the anobiid beetle breeding in stems of ivy in Roanoke, Va., is a European species, *Ochina ptinoides* Marsh., and that a European weevil, *Brachyrhinus ligustici* L., had recently been collected at Oswego, N.Y. Many larvae of a chrysomelid beetle, *Exosoma lusitanica* L., which is a potential pest of bulbs, were submitted for identification following interceptions in Cipollina bulbs from Morocco. A weevil responsible for considerable injury to onion and garlic in Texas proved to be a native species, *Ceutorhynchus tau* Lec., which has remained unknown since initially described. Studies to define the characters which would distinguish certain noctuid moths of the genus *Heliothis* cleared up a number of uncertain points and demonstrated that the report of the occurrence in this country of the European species, *dipsacea*, is without foundation. Research on a related group of moths established the fact that one of the pests of peppers which caused the rejection of shipments of this vegetable from Mexico was identical with a species rather generally distributed throughout the Southwest but recorded under another name.

INSECT PEST SURVEY AND PUBLIC RELATIONS

This work has continued under the direction of J. A. Hyslop.

INSECT PEST SURVEY

During the past year the insect pest survey has issued monthly reports on current insect conditions for the information of Federal and State entomologists and others associated with entomological work. These reports are based on collaboration with such official and other entomologists of the United States and its insular possessions and also of Canada, Mexico, Guatemala, Costa Rica, Cuba, Haiti, and Brazil. From its records it has furnished specific information for the use of the personnel of this Bureau and of the Bureau of Plant Quarantine and to entomologists in the several States and others in interest. The records of the survey now include notes on over 27,000 species of insect pests in nearly 11,000 genera.

PUBLIC RELATIONS

The public-relations feature of this office concerns three subject-matter specialists in entomology who work in cooperation with the extension personnel in the several States.

In connection with the very severe grasshopper outbreak in the northern Plains States, one of these specialists has for the past two seasons spent considerable time in aiding the control campaign in North Dakota. This season (1933) he organized largely the work in this State in 36 counties with the result of an indicated saving of crops to the value of about $2,000,000.

This service has rendered material aid, also, in securing the adoption of the new spray services and schedules for tree fruits in several States. In two States special assistance and demonstrations were given to train State leaders in the preparation and use of chemically treated bands for supplemental codling-moth control—a very valuable means recently developed by the Bureau.

Another important feature of this extension service has concerned the adoption of measures developed by the Bureau for the control of bots in

horses and mules—a type of injury which has been on the increase. Over 300,000 horses and mules in seven States have been treated as a result of the activities of these specialists. In Illinois alone this work has concerned 136,000 horses, or 1 out of every 6 horses in the State.

Similarly, cattle-grub control has been stimulated and aided in Illinois, Iowa, and Missouri by discussions at meetings and other types of publicity.

These agents have also cooperated in aiding educational features at boys' and girls' 4-H club camps to give these prospective farmers and home makers information on entomological problems.

Similarly, film strips on entomological subjects have been utilized in many States and assistance has been given in the preparation of motion pictures.

Another activity of this work has been the preparation of exhibit material, and particularly the preparation of exhibits for the Century of Progress Exposition.

INSECT PHYSIOLOGY AND TOXICOLOGY

The work on insect physiology and toxicology, under the direction of Frank L. Campbell at the Takoma Park (Md.) laboratory, is concerned primarily with basic investigations of the reaction of insects to poisons. An important phase of the work is the testing of new insecticides developed by the Bureau of Chemistry and Soils. These tests of many different substances and compounds cannot, under space limitation, be here given detailed consideration. Special mention, however, should be made of the investigation of derris root and its derivative, rotenone, in various combinations and in relation to different types of insects. Studies have also been made of nicotine, of acetone extracts of various plants, and of synthetic organic compounds, against mosquito larvae. None of these tests with mosquito larvae has so far shown much promise. Other series of tests have had relation to stomach poisons for leaf-feeding insects.

As bearing on studies of poisons, attractants, etc., technical studies of the sense organs and of the physiological and metabolic activities of insects have been continued.

U.S. GOVERNMENT PRINTING OFFICE: 1933

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REPORT OF THE CHIEF OF THE OFFICE OF EXPERIMENT STATIONS, 1933

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D.C., September 1, 1933.

SIR: I transmit herewith a report of the Office of Experiment Stations for the fiscal year ended June 30, 1933.

Respectfully,

JAMES T. JARDINE, *Chief.*

Hon. HENRY A. WALLACE,
Secretary of Agriculture.

FUNCTIONS OF THE OFFICE OF EXPERIMENT STATIONS

The Office of Experiment Stations was established in 1888, following the passage of the Hatch Act of March 2, 1887, which made the initial appropriation of Federal funds for the State experiment stations, to give such advice and assistance as it was thought would best promote the purposes of that act, namely,

> to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science.

Later legislation enlarged the functions of the Office by directing the Secretary of Agriculture to prescribe the form of the annual financial statement required by the Hatch and supplementary acts, to ascertain whether the expenditures under these acts are in accordance with the provisions of the acts, to coordinate the work of the Department of Agriculture with that of the experiment stations, and to report thereon to Congress. Department supervision of the use of Federal funds for the support of the experiment stations in Hawaii and Puerto Rico is provided for in the annual agricultural appropriation acts.

Following the passage of the Adams Act of March 16, 1906, and the Purnell Act of February 24, 1925, supplementing the Hatch Act, the duties of the Office were further enlarged by Executive order, approved by the Association of Land-Grant Colleges and Universities, that projects supported by funds provided by these acts must have approval of the Office before they are undertaken, subject to amendment from time to time as progress of the work on them may require.

In discharge of the functions thus defined the Office, during the year ended June 30, 1933, administered Federal funds provided by the Hatch, Adams, and Purnell Acts for the experiment stations in

the several States and in Alaska, Hawaii, and Puerto Rico, amounting to $4,374,000 ($90,000 for each State, $15,000 for Alaska, $24,000 for Hawaii, and $15,000 for Puerto Rico), as well as special appropriations for support of experiment stations in Hawaii and Puerto Rico, amounting to $103,560, or a total of $4,477,560, furnishing such information, assistance, and advice as in its judgment would best promote the purposes of the Federal acts. The Office also endeavored to coordinate the work of the Department and the stations and to adapt it to the needs of the Nation as a whole, "having due regard to the varying conditions and needs of the respective States and Territories", as provided in the several acts.

EXAMINATION OF STATION WORK AND EXPENDITURES

In accordance with the terms of the Federal acts, the financial reports of station income and expenditures are not due until September 1. Preliminary figures secured in connection with the annual examination, however, clearly indicate a reduction in income for the year, due in part to reduced State appropriations and in part to reduced revenue from receipts and outside contributions for research. At the same time reports from the directors and information gained in the annual examination indicate that the demand upon the stations was greater than in any other year in their history. As a consequence, some adjustments in programs of research were necessary during the year, and with the new production season near the close of the year the majority of the stations were confronted with the necessity of realigning their programs consistent with reduced finances and the local, regional, and national problems of agricultural adjustment. In view of this situation, the personal annual examination of every State station was made by representatives of the Office during the period April–June.

In addition to injury as to the work and expenditures under the Federal funds, as authorized in the acts, the Office representatives conferred with directors and staff members of the State stations regarding all research of the stations, the problems confronting the stations, and proposed adjustments of work and funds. This first-hand knowledge of the respective local situations served to place the Office in a position to act upon the new program of research on the Federal funds, due approximately July 1, 1933, in a way to be most consistent and helpful in meeting the difficulties and new demands on the respective stations and in making suggestions for integration of the State programs with Federal objectives and programs.

During the year a total of 433 Adams projects and 1,437 Purnell projects, besides a large number of projects supported by Hatch, State, and other funds, active during the year, were examined in detail as to progress, cost, and possible improvements. The Adams projects, dealing primarily with fundamental research, and the Purnell projects, somewhat broader in plan and purpose and providing specifically for research in economics, sociology, and home economics, as well as in production, were distributed by major objectives as follows:

Distribution of Adams and Purnell projects by major objectives

Item	Projects		Amount expended 1932–33	
	Adams	Purnell	Adams	Purnell
	Number	*Number*		
Improvement, more economical production, and better utilization of plants and plant products:				
Improving quality, disease resistance, and hardiness by breeding	53	91	$93,570	$173,164
Protection against insects, plant diseases, and rodents	137	195	166,210	274,721
Conservation, maintenance, and management of the soils and crops	83	261	156,729	532,929
Improved methods of handling, storing, utilizing, and marketing of plant products	16	148	32,791	268,727
Physiology of growth and fruiting	30	47	55,038	78,909
Improvement, more economical production, and utilization of farm animals and animal products:				
Development of improved animals by breeding	18	24	27,783	41,567
Feeding and management for more economical production	44	181	98,073	417,016
Protection against diseases and parasites	44	66	84,727	118,674
Efficient handling, processing, and marketing practices	7	133	6,760	249,380
Physiology of growth, reproduction, and milk flow	1	19	2,500	37,963
The betterment of the family, the home, and the community:				
Physical improvement of the family through new knowledge of food composition, improvement in food preparation, analyses of dietary practices, development of new standards, and fundamental discoveries concerning factors affecting growth, nutrition, and health	----	48	----	117,875
Betterment of the home through information on household equipment and its arrangement and efficient use, factors affecting the selection and care of clothing and textile fabrics, methods and standards of household buying, consumption habits and standards, possibilities of contributions of home makers to family income, and factors determining standards of living in various sections of the country	----	51	----	118,172
Social organization and improvement	----	36	----	74,260
Population movement and changes	----	9	----	13,862
Farm business improvement:				
Taxation	----	24	----	53,980
Land utilization	----	15	----	46,759
Financial relationships—tenancy, mortgages, investments, adjustments	----	14	----	29,680
Business organization and cost	----	54	----	140,501
Marketing organizations	----	21	----	45,094
Total	433	1,437	724,181	2,833,233

The foregoing grouping is approximately on the basis of the major purpose of the individual project. Naturally much research concerning plants and animals and their products has a very definite relationship to land utilization. The land-utilization subdivision includes only studies organized specifically to integrate all available information and factors for the development of a specific or rather comprehensive land-utilization program of a given area or State. Much research grouped under plants and animals and their products in an ordinary classification would be classified as agricultural economics. In a similar way most of the studies ordinarily classified as agricultural engineering fall under the studies of plants and animals and their products when grouped according to major objective.

COOPERATION AND FEDERAL-STATE RELATIONS

The Office encouraged and promoted cooperation between the Department and the stations in every practicable way at its command, and, in association with the Director of Scientific Work of the Department, A. F. Woods, various chiefs of bureaus, and representatives

of the Association of Land-Grant Colleges and Universities, it aided in bringing about a better understanding between the bureaus of the Department and the stations regarding cooperation and the principles which should control the relations between the Department and the experiment stations.

Through membership on the joint committee on projects and correlation of research of the Association of Land-Grant Colleges and Universities, the Office was able to furnish pertinent information needed by this committee and had an opportunity to aid in shaping its policies and recommendations. This committee, at its last annual meeting, recommended the development of a national land-use project, to be participated in by the Department and the stations.

Cooperative agreements between the Department and the stations were examined and recorded as heretofore. The record shows that about 1,000 of the 7,000 or more active station projects, not including a large number of informal cooperative undertakings, are now carried on cooperatively by the Department and the stations. All but 2 of the 50 State stations and all but 1 of the research bureaus of the Department are represented in this cooperative research.

EXPERIMENT STATIONS IN ALASKA, HAWAII, AND PUERTO RICO

With the retirement, January 31, 1933, of Walter H. Evans, who for many years had been in direct charge of the administration of the experiment stations in Alaska, Hawaii, Puerto Rico, Guam, and the Virgin Islands, this duty was assumed by the Chief of the Office. Appreciative acknowledgment is here made of the long and efficient service of Dr. Evans, not only in this capacity but as Acting Chief of the Office for a time, one of the larger contributors to Experiment Station Record in the fields of plant physiology and pathology, and in fact in all the major activities of the Office during the 41 years of his continuous connection with it.

The formal closing of the Alaska and Guam stations and the transfer of the Virgin Islands station to the Department of the Interior were completed early in July. There remained, however, a good deal of work, which was accomplished during the year, in the preparation of material for publication in order to make available such findings as were considered of importance to the local people. Also, during the year the Office handled a great many inquiries, especially regarding agriculture in Alaska.

ALASKA STATIONS

The Alaska Experiment Stations passed from the direct jurisdiction of the Department of Agriculture at the beginning of the year. The headquarters at Juneau and the station at Sitka were closed. The station at Matanuska was transferred to the Agricultural College and School of Mines at Fairbanks. This station and the Fairbanks station, formerly transferred, have become the basis of the Territorial experiment station, established and receiving Federal funds through an extension of the benefits of the Federal Hatch Act to the Territory in 1929. Its income from the Federal act was $15,000.

HAWAII STATION

The Federal experiment station in Hawaii, coordinated with that of the University of Hawaii, continued to be operated under the direction of J. M. Westgate, with funds appropriated for the purpose to the Department of Agriculture, $40,000; from extension of the Hatch and Adams Acts to Hawaii, $24,000; and from other sources, $30,500. The relation of this station to the Department has become in a measure the same as that of the State experiment stations.

In recognition of the fact that sugar and pineapples, the leading agricultural industries of the island, are well cared for by other agencies, the work of the Hawaii station supported by Federal funds was, as in previous years, directed mainly toward developing a more diversified and self-sustaining agriculture. Some of the more significant features of the work of the station during the year dealt with improvement of ranges and introduction of better grasses and forage crops, improvement of coffee culture in the islands, control of poultry diseases and better methods of feeding and management of poultry, and study of oriental foods and their place in the diet of the islands.

PUERTO RICO STATION

The status of the Puerto Rico Experiment Station remained the same as in previous years. The act of Congress of March 4, 1931, made possible the extension of the benefits of the Hatch, Adams, and Purnell Acts and the Federal extension acts to Puerto Rico and provided for coordinating agricultural research and extension activities in the island. Up to the close of the year Puerto Rico had not complied with the terms of the Federal act through satisfactory legislative acceptance of its provisions and the contemplated coordination had not been brought about. The Federal station at Mayaguez was maintained, as heretofore, under the direction of T. B. McClelland.

The Puerto Rico station continued to give major attention to development and introduction of improved sugarcane varieties, coffee fertilizing and cultural practices, tests of varieties of pineapples, control of animal parasites, and general service in aid of a more self-sustaining agriculture. The retirement of H. C. Henricksen, in charge of citrus and pineapple investigations, with headquarters at San Juan, made necessary the discontinuance of a much needed service. For a time the growers continued Mr. Henricksen's services by a tax upon their own products. The hurricane in September 1932, however, practically destroyed their current crop and they were without funds to continue the work.

The total income of the station, derived entirely from direct Federal appropriations through the Department of Agriculture, was $63,560. Of this amount, however, approximately $16,500 was impounded, inasmuch as positions vacant could not be filled.

EXPERIMENT STATION RECORD

Experiment Station Record was one of the first agencies established in the Office of Experiment Stations to aid the stations in carrying out the purposes of the Federal acts providing for their

support. Limited at first simply to abstracts of station publications, it has expanded as the need increased, until it has now become a comprehensive review of current literature and progress of research in agriculture and home economics.

Under the editorship of H. L. Knight, the Record functions as an integral part of the activities of the Office. During the year covered by this report volumes 67 and 68 were completed, and, in addition to the customary indexes for individual volumes, a fifth general index, covering volumes 51–60 and the period 1924–29, was issued in limited edition. A reprint was also arranged for the general index for volumes 1–12, the original edition of which had long been exhausted.

Monthly issues averaging 150 pages each replaced the former combination of 12 monthly and 6 supplementary numbers per year, each of 100 pages. This change to fewer and larger numbers brought about substantial savings in printing and mailing costs. An extensive revision of the mailing list, especially as regards the foreign distribution, made possible a curtailment of the edition, and the information developed in the course of this revision was also drawn upon in the preparation of the list of agricultural research institutions in foreign countries referred to on page 10.

The pressure for sufficient space for the prompt publication of material was measurably relieved by greatly shortening the abstracts of the annual reports of the State experiment stations. Under the new plan these abstracts no longer contain the results of the investigations, but merely describe the work in sufficient detail to permit of appropriate index entries. Largely as a result of this change in policy, although the total number of pages devoted to abstracts in the two volumes was decreased from 1,682 to 1,600, the number of abstracts increased from 5,561 to 6,430. This increase was in part in abstracts of articles appearing in foreign languages and relatively unavailable publications, to meet the urgent needs of research workers to many of whom these articles would otherwise have been practically inaccessible. More room was also made possible for some expansion in the fields of agricultural economics and rural sociology. In order to cover these fields more completely, B. Youngblood was added to the Record staff, and the work in rural sociology was segregated as a distinct unit under his direction. Other changes in personnel included the retirement on January 31, 1933, of Walter H. Evans, and on February 28 of William E. Boyd.

The retirement of the entire botanical staff of the Record created some interruptions in this phase of the work, although the abstracting of experiment station and Department publications was continued by specialists in other fields. At the end of the year arrangements were being concluded for closer cooperation with Biological Abstracts in the preparation of botanical material. During the year copies of abstracts of experiment station publications prepared for the Record were again made available to Biological Abstracts, and both journals were supplied with author abstracts of most Department publications through the cooperation of the Office of Information.

OTHER BASIC INFORMATION SUPPLIED

In addition to the service rendered by Experiment Station Record, complete and up-to-date information regarding personnel and organization of experiment stations and improvements in their facilities for research, as well as similar data for research institutions in other countries, were collected as usual and made available for the use of the Department and the experiment stations. The list of Workers in Subjects Pertaining to Agriculture in State Agricultural Colleges and Experiment Stations, 1932–33, printed as Miscellaneous Publication no. 154 of the Department, monthly and biennial lists of station publications, and a list of Agricultural Research Institutions and Library Centers in Foreign Countries, issued in mimeographed form as an aid in revising mailing lists, are typical examples of such service.

For the benefit of librarians and others interested in the published output of the stations, the Office continued its monthly mimeographed list of station publications. Reduced printing funds, however, made it necessary to discontinue the weekly list of station publications which had previously been printed in The Official Record. The Office continued the preparation of indexed biennial supplements to the list of station bulletins.

CHANGES IN OFFICE PERSONNEL

Important changes occurred in the personnel of the Office during the year. As already stated, Walter H. Evans, chief of the Division of Insular Stations, retired January 31, 1933; W. E. Boyd, assistant botanist on the staff of Experiment Station Record, retired February 28, 1933; and H. C. Henricksen, agriculturist of the Puerto Rico station, retired June 30, 1932, all of them having reached the compulsory retirement age.

Dr. Evans, during his 41 years' connection with the Department, first as special agent in botanical work, then as botanical editor of Experiment Station Record and chief of the Division of Insular Stations, and for a time as Acting Chief of the Office in addition to his other duties, rendered especially notable service in the establishment and development of experiment stations, under the immediate direction of the Department of Agriculture, in Alaska, Hawaii, Puerto Rico, Guam, and the Virgin Islands, as well as in promoting the work of the State agricultural experiment stations in general, but especially in the fields of plant physiology and pathology.

W. E. Boyd, who had been connected with the Office since 1911, was a prolific contributor to Experiment Station Record of abstracts of scientific articles in many languages in the fields of botany and plant physiology.

H. C. Henricksen, in charge of citrus and pineapple investigations of the Puerto Rico station since 1916, had rendered especially notable service in solving the problems and improving the practice of citrus and pineapple growers and shippers.

With the closing of the Federal stations in Alaska, June 30, 1932, the following were released: H. W. Alberts, principal agronomist

and director; F. L. Higgins, senior agronomist; W. T. White, animal husbandman; J. C. Wingfield, associate horticulturist; C. Cordy, assistant horticulturist; M. Koenigs, senior clerk-stenographer; and E. Hansen, administrative officer. Director Alberts and Mr. White were retained for a short period under the appropriation for closing the stations. Mr. Hansen was retired for disability on July 31, 1932.

The Guam station was closed June 30, 1932, releasing the following: C. W. Edwards, senior animal husbandman and director; S. R. Vandenberg, associate entomologist; A. I. Cruz, assistant scientific aid; J. Guerrero, junior scientific aid; F. B. L. Guerrero, junior scientific aid; and P. Nelson, principal clerk. Mr. Edwards was transferred as associate animal husbandman to the Bureau of Animal Industry on August 6, 1932.

The Virgin Islands station passed under the jurisdiction of the Department of the Interior, July 8, 1932, and the following members of the station staff were transferred to that Department: Glen Briggs, agronomist and director; G. A. Roberts, animal husbandman and veterinarian; C. L. Horn, associate horticulturist; N. N. Nichols, associate animal husbandman and dairyman; H. L. Cawley, assistant home demonstration agent; D. S. Blackwood, farm superintendent; and A. A. Moorehead, office aid and stenographer. The following, released with the closing of the station, were not taken over by the Department of the Interior: W. M. Perry, horticulturist, and A. Bisserup, clerk.

PUBLICATIONS

Publications by the Office during the year were limited strictly to such as seemed essential to the proper functioning of the Office and of the experiment stations under its immediate control and to the discharge of its obligations under the law. There were sharp retrenchments in size and edition of publications.

Publications printed by the Department for the Office during the year ended June 30, 1933, included the usual numbers and indexes of Experiment Station Record, as well as a general index to volumes 51 to 60 (p. 6), other printing being curtailed somewhat to provide more adequately for the Record.

Exclusive of the Record, the following publications of the Office were printed:

Report of the Chief of the Office of Experiment Stations, 1932, by James T. Jardine; and Report on the Agricultural Experiment Stations, 1931, by J. T. Jardine, W. H. Beal, H. M. Steece, et al.

Miscellaneous Publication 154, Workers in Subjects Pertaining to Agriculture in State Agricultural Colleges and Experiment Stations, 1932-1933, by M. A. Agnew.

Alaska Stations Bulletin 11, Forage Crops in the Matanuska Region, Alaska, by H. W. Alberts; Circular 4, Field Crops for Interior Alaska, by F. L. Higgins; and Report of the Alaska Agricultural Experiment Stations, 1931, 1932.

Hawaii Station Bulletin 65, Range Grasses of Hawaii, by J. C. Ripperton, R. A. Goff, D. W. Edwards, and W. C. Davis; and Report of the Hawaii Agricultural Experiment Station, 1932.

Report of the Puerto Rico Agricultural Experiment Station, 1932.

Report of the Virgin Islands Agricultural Experiment Station, 1932.

Publications in press or in course of preparation for printing by the Department at the close of the year included several numbers of Experiment Station Record and a reprint of the general index to volumes 1 to 12; Report on the Agricultural Experiment Stations, 1932, by J. T. Jardine and W. H. Beal (in press); Alaska Stations Circular 5, Feeding Dairy Cows in the Matanuska Region, Alaska, by W. T. White (submitted for printing); Report of the Guam Agricultural Experiment Station, 1930-31, 1931-32 (in press); Hawaii Station Bulletin 68, Japanese Foods Commonly Used in Hawaii, by Carey D. Miller (submitted for printing); and A History of Agricultural Experimentation and Research in the United States, 1620-1925, Including a History of the United States Department of Agriculture, by Alfred Charles True (resubmitted for printing).

The following were edited for publication through the insular experiment stations.

Hawaii station: Bulletins 67, Cane Molasses in Poultry Rations, by C. M. Bice (approved for publication in Hawaii); 69, The Manufacture of Poi from Taro in Hawaii, with Special Reference to Its Fermentation, by Ethel K. Allen and O. N. Allen (approved for publication in Hawaii); 70, Citrus Culture in Hawaii, by W. T. Pope (approved for publication in Hawaii). Circulars 5, Poultry Diseases Common in Hawaii, by C. M. Bice (printed in Hawaii); 6, Grafting Tropical Fruit Trees in Hawaii, by W. T. Pope and William B. Storey (printed in Hawaii); 7, Capons and Caponizing, by C. M. Bice (approved for publication in Hawaii). Some Factors Affecting the Electrolytes of the Starch Granule, by D. W. Edwards and J. C. Ripperton (prepared for publication in Journal of Agricultural Research); and The Nutritive Value of Mountain Apple (*Eugenia malaccensis* or *Jambosa malaccensis*), by Carey D. Miller et al. (approved for publication in the Philippine Journal of Science).

Puerto Rico station: Maize Prepotency in Second-Generation Lines, by R. L. Davis (prepared for publication in Journal of Agricultural Research).

Virgin Islands station: Bulletin 7, Permanent Pastures for the Virgin Islands, by Glen Briggs (approved for publication in the Virgin Islands).

The preceding summary shows that the Office printed or prepared for publication during the year 40 documents aggregating approximately 3,700 pages.

LIBRARY AND BIBLIOGRAPHICAL SERVICE

The library of the Office, in charge of Cora L. Feldkamp, cooperating with the Department Library and with the Extension Service, maintained as in previous years files of station, extension, Department, and other publications, which were made readily available for review in Experiment Station Record, for consultation by the Department as a whole, and, as far as facilities would permit, to State institutions and others. During the year the library circulated for this purpose 2,433 books and 26,986 periodicals.

The sixth supplement to Department Bulletin 1199, giving an indexed list of station bulletins for the calendar years 1931 and

1932, was prepared for publication by C. E. Pennington. Other bibliographical work included a continuation by H. V. Barnes of the index of articles contributed by the stations to outside journals. Short abstracts of 49 station and extension publications relating to rural life were prepared for publication by the American Library Association.

SPECIAL ACTIVITIES AND SERVICES

Conferences, service on departmental and other committees, and preparation of special reports, papers, compilation of information, and exhibits relating to the work of the Office and the experiment stations, and the voluminous correspondence made necessary by these and other activities, always an important feature of the work of the Office, claimed an unusually large part of the time and attention of the Office during the year, but by such means the helpful relations which have always been maintained with the bureaus of the Department, the experiment stations, and other agencies for agricultural research were broadened and strengthened.

All of the State stations were visited by one or more representatives of the Office, not only for the purpose of examining their work at first hand and inquiring particularly into the use being made of the Federal funds, but also for discussing adjustments made necessary by reduced financial support and increased calls for information and emergency service. Such calls, both on the stations and on the Office, were more numerous and urgent during the year than at any other previous time, except possibly during the World War. They were met with many evidences of appreciation by those most directly concerned. The following are a few specific examples of such service by the Office:

DISTRIBUTION OF STATION PUBLICATIONS

The Chief of the Office continued to serve on the committee on experiment station organization and policy of the Association of Land-Grant Colleges and Universities and assisted in the preparation of that part of its report at the last annual meeting dealing particularly with the distribution of experiment station publications in other countries. In collaboration with H. L. Knight, he assisted a special committee of the association in working out a plan for this purpose, the first step in which was the compilation of a list of agricultural research institutions and library centers in foreign countries, to serve as a basis for planning distribution of publications. This list enumerates about 300 "primary research institutions" in foreign countries deemed outstanding as to agricultural research or library facilities, and about 950 "additional institutions." The list was mimeographed and distributed to the State experiment stations as an aid in formulating distribution policies and as a basis for future study of the general problem. This action is considered especially significant because wide differences in policies have prevailed among the individual stations as regards distribution of publications, and one of the principal difficulties has been a lack of adequate and up-to-date information regarding agricultural research institutions abroad.

LAND-USE RESEARCH

B. Youngblood, representing the Office, continued to serve as secretary of the joint committee of the Department and the Association of Land-Grant Colleges and Universities on projects and correlation of research, and assisted in preparing a report of the committee on Department and station cooperative projects and on land-use research, which recommended the formulation of a national cooperative land-use research and planning project to be participated in by the Department and all of the experiment stations. Dr. Youngblood also served on a subcommittee of the National Land Use and Planning Committee appointed to draft the proposed national project on land use and planning.

AGRICULTURAL ENGINEERING RESEARCH

Research in agricultural engineering continued to be aided by the service of R. W. Trullinger on various committees of the American Society of Agricultural Engineers and in other ways. He continued as a member of the research committee of the society, which deals with organization and coordination of research and the preparation of research programs in agricultural engineering, and presented reports at the annual convention of the society on the interpretation of results of research in farm machinery in terms of crop-value units and the future development of research in agricultural engineering. In addition he supervised the preparation of a monthly digest of agricultural engineering progress and served on committees of the society dealing with agricultural engines, research in tractor fuels and lubricants, and rural sanitation, being chairman in the last connection of a committee cooperating with the American Public Health Association and the Conference of State Sanitary Engineers. He also was the official representative of the Society on American Engineering Council and was a member of its committees dealing with engineering features of national reforestation policies and production, distribution, and consumption of necessary commodities.

HOME ECONOMICS RESEARCH

As in previous years, Sybil L. Smith, home economics specialist of the Office, conferred with home economics leaders in various parts of the country on the advancement of research in this field, and served on various committees of the Association of Land-Grant Colleges and Universities and the American Home Economics Association dealing with this subject. She presented a report of progress in home economics research at the 1932 meeting of the former association, which was prepared in mimeographed form for limited distribution to home economics workers. She also prepared a review of home economics projects at the land-grant institutions and a list of references to published reports on home economics research receiving Federal support, which were mimeographed for limited distribution. She was appointed contributing editor of the foods and nutrition department of the Medical and Professional Woman's Journal, and in that capacity contributed a paper on

vitamins to the journal. She also contributed the section on Home Economics Research as a Profession, for the second edition of Careers for Women, edited by Catherine Filene Shouse.

AGRONOMIC RESEARCH METHODS

H. M. Steece continued to serve on the committee on standardization of field experiments of the American Society of Agronomy, which formulates and recommends standard technic for field plat experiments in soil fertility and farm crops, and made additions to a bibliography concerning standardization of field experiments, published in the Journal of the American Society of Agronomy, 24 (1932), No. 12, pp. 990–992. He also took part in numerous informal conferences with Department and station specialists and with foreign scientists visiting the Department and the experiment stations.

METHODS OF MEAT PRODUCTION RESEARCH

A representative of the Office, H. W. Marston, attended the conference of representatives of institutions engaged in cooperative meat investigations held in Chicago, August 15–17, 1932, and served on committees of the conference on cooking and palatability methods, pork products, and performance studies, having as their object improved and standardized research methods and technic.

ADVANCED TRAINING FOR RESEARCH IN GENETICS

At the request of the committee on graduate instruction of the American Council of Education, George Haines assisted in preparing a list of investigators and institutions in the United States adequately prepared to offer work toward the doctor's degree in genetics.

MICROSCOPIC TECHNIC

A technical contribution not directly related to the work of the Department or the stations, but proposing certain definite improvements of microscopic technic of interest and value in agricultural research, was made by H. C. Waterman as a product of work outside of official hours. Papers reporting this work were prepared for publication.

ACCRUED INTEREST ON FEDERAL FUNDS

A ruling of the Comptroller General of the United States, that accrued interest on Federal funds provided by the experiment station and extension acts must be covered into the Treasury of the United States, required detailed consideration of the best means of handling and accounting for the interest. A procedure which appears to meet the new requirements was formulated and as promptly as possible communicated to the institutions concerned.

U. S. GOVERNMENT PRINTING OFFICE: 1933

REPORT OF THE DIRECTOR
OF
EXTENSION WORK

See

REPORT OF
EXTENSION WORK
IN
AGRICULTURE AND HOME ECONOMICS
IN THE UNITED STATES

1933

REPORT OF THE CHIEF OF THE FOOD AND DRUG ADMINISTRATION, 1933

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOOD AND DRUG ADMINISTRATION,
Washington, D.C., August 31, 1933.

SIR: I submit herewith the report of the Food and Drug Administration for the fiscal year ended June 30, 1933.

W. G. CAMPBELL, *Chief.*

Hon. HENRY A. WALLACE,
Secretary of Agriculture.

INTRODUCTION

The end of the fiscal year covered by this report marked the completion of 26½ years of enforcement of the Federal Food and Drugs Act. During that period more than 22,000 actions under the law have been brought to a conclusion.

A law which, in the course of more than a quarter century, has resulted in more than 22,000 actions for adulteration and misbranding of foods and drugs has justified its enactment. There can be no doubt that Harvey W. Wiley and his associates, who framed the present pure-food law and fought successfully for its enactment, wrought well. If the present law does not control all serious abuses now existent in the food, drug, and related fields, it is to be attributed to the inability of any man a generation ago to anticipate the restrictive effect of interpretative court decisions and to foresee the changes that a quarter century would bring in manufacturing and merchandising technic.

Within a very short time after its passage, however, it became apparent that serious defects in the law did exist. In 1917 the Chief of the Bureau of Chemistry said, in his annual report:

> While the accomplishments of the Food and Drugs Act have been considerable, it must be admitted that it has its serious limitations. Especially conspicuous ones are the lack of legal standards for foods, of authority to inspect warehouses, and of any restriction whatever upon the use of many of the most virulent poisons in drugs; the limitations placed upon the term "drug" by definition which render it difficult to control injurious cosmetics, fraudulent mechanical devices used for therapeutic purposes, as well as fraudulent remedies for obesity and leanness; the limitation of dangerous adulterants to those that are added so that the interstate shipment of a food that naturally contains a virulent poison is unrestricted. Furthermore, the law fails to take cognizance of fraudulent statements covering foods or drugs which are not in or upon the food or drug package

The Secretary of Agriculture had previously recommended legislation to fill most of the gaps in the law mentioned in that report.

The Food and Drug Administration, which took over the enforcement of the act in 1927, has continued to call attention to the loopholes in the law, both in annual reports and in other publications, and to seek legislative remedies. This culminated, during the latter part of the fiscal year just closed, in the preparation in the Department of Agriculture, with Presidential approval, of a complete revision of the Food and Drugs Act and its introduction in the Senate on June 12 1933, in the closing days of the first session of the Seventy-third Congress, as Senate bill 1944. A measure of such vast importance to the American consumer is worthy of more than passing attention in this report. It will be discussed in some detail following the summary of the year's work on food and drug enforcement.

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THE FOOD AND DRUGS ACT

SAMPLES, INTERSTATE AND IMPORT ACTIONS

In the course of the year 47,646 samples of foods and drugs were collected and examined, of which 22,205 were from importations and 10,012 were samples, designated as informal because they had not moved interstate, collected and examined as a guide in directing regulatory work. The remaining 15,429 were official samples from interstate shipments. The official samples represented the output of approximately 9,105 manufacturers, of whom 2,698 were responsible for some degree of violation. Examination consisted in most instances of chemical analysis, supplemented when needful by bacteriological, microscopical, or pharmacological studies.

Table 1 contains a condensed summary of the actions taken under the interstate provisions of the law.

TABLE 1.—*Summary of prosecutions and seizures under the Food and Drugs Act, fiscal year ended June 30, 1933*

Item	Prosecutions	Seizures	Total
Food	638	1,195	1,833
Drugs	453	416	869
Stock feeds	62	13	75
Total	1,153	1,624	2,777

The number of seizures and prosecutions reported is not a complete measure of the corrective results obtained, for warnings and constructive educational work and the moral effect of regulatory action prevent many violations. That more than one fourth of the manufacturers given attention were found responsible for some degree of violation does not indicate that this ratio persists throughout the industries. Those manufacturers are given first attention whose practices, as determined by factory inspection or informal exploratory sampling, give most reason for anticipating violations. Official interstate samples are carefully selected on the basis of this knowledge and necessarily show a high percentage of violation if sampling is properly directed.

A comparison between the number of legal actions instituted during the past year and the total of the last 6 years is informative. The Food and Drug Administration came into existence on July 1, 1927. During the succeeding 6 fiscal years it has instituted 3,751 criminal prosecutions and 6,900 seizures under the Food and Drugs Act, a total of 10,651 cases. This total is very much larger than that of any preceding 6-year period. This is to be attributed in part to the vast increase in the volume of interstate food and drug traffic since the law became effective in 1907, in part to experience gained in enforcement, which has made it possible to direct regulatory activities more effectively than ever before, and in part, as pointed out in the last annual report, to the increased working funds made available to the Administration during the years beginning with 1930.

Table 2 summarizes the work under the import section of the act.

TABLE 2.—*Import actions at port laboratories during fiscal year ended June 30, 1933*

Item	Examined and detained	Examined and released	Total
Foods	2,156	14,808	16,964
Drugs	1,089	4,152	5,241
Total	3,245	18,960	22,205

In addition to the samples analyzed, as listed in table 2, several thousand inspections were made of food and drug consignments offered for entry to determine their fitness for importation. Penalties under bonds, collected through the Treasury Department during the year, amounted to $4,326.26.

EFFECT OF WITHDRAWING RECONDITIONING PRIVILEGES

An announcement to the trade was issued on August 22, 1932, advising that the privilege of conditional entry of import shipments of nuts for the purpose of sorting and separating unsound and refuse nuts would be discontinued on and after September 1, 1933. This announcement extends the list of foreign-produced foods and drugs upon which such reconditioning privilege is withdrawn, as stated in the Administration's annual report for the fiscal year ended June 30, 1932.

This policy, inaugurated several years ago, has had a marked effect on the character of importations offered for entry, particularly those at ports in the Eastern District, and detentions of the commodities affected have not been so frequent as formerly. This development is a decided economic advantage to the operations of the station as a whole because it permits application of time and funds saved through fewer inspections of reconditioned or relabeled shipments to the investigation of other projects or the inauguration of new work.

TIME DEVOTED TO DIFFERENT TYPES OF VIOLATIONS

It has been customary in recent reports to divide types of food violations into three classes, namely, those involving public health, those resulting from filth and decomposition, and those creating an economic fraud. The first two classes may be broadly described as hygienic violations. Actions on drugs are also in the public-health class. Our records for the past fiscal year show that 83.9 percent of our working time was devoted to interstate food and drug traffic and 16.1 percent to imports. On the basis of types of products, 27 percent of our time was directed to drug products; 30.3 percent to fruits and vegetables, principally articles contaminated with poisonous spray residues; 8.9 percent to fisheries products, largely to types of violations involving filth and decomposition; and 8.1 percent to other hygienic violations. A total, therefore, of 74.3 percent of the working time of the Food and Drug Administration was directed to the control of types of violations principally hygienic in character, leaving 25.7 percent available for economic violations. Dairy products, including principally butter and cheese, required 8.7 percent of the remaining time, so that for all other economic violations approximately 17 percent of the time was available.

FOOD ADULTERATIONS INVOLVING PUBLIC HEALTH

As has just been shown, the traffic in fruits and vegetables bearing poisonous spray residues continues to claim a major part of the attention of the Administration. A tolerance of 0.01 grain of arsenic trioxide per pound of food is now met by a large part of the interstate traffic in fruits and vegetables. While the campaign waged for years to keep the poisonous residue on fruits within safe limits has recognized the lead hazard as well as that of arsenic, emphasis has heretofore been placed on the need for reducing the arsenic load of the fruit. This has been done because of the fact that the conventional hydrochloric acid wash method advocated by the Department, and protected by a public-service patent issued to the Department, exerts a proportional solvent action on both lead and arsenic. In the absence of a rapid and accurate method for estimating minute quantities of lead residues, it seemed best to rely on the determination of arsenic, which can be quickly and accurately done, to estimate the extent of contamination by both poisons since these are present in acid-washed fruit in reasonably constant proportions. Unfortunately, last fall certain apple packers elected, in good faith, to employ washing solvents other than hydrochloric acid, overlooking the fact that while these solutions reduced the arsenic load satisfactorily, they had little or no effect upon the lead. The development by the Department of accurate methods of analysis for lead in minute quantities, led to the discovery of commercial shipments of apples satisfactory as to arsenic but containing high lead residues. This necessitated numerous seizures and indicated the importance of establishing a formal tolerance for lead as well as for arsenic. On June 20, 1933, the Department announced a tolerance of 0.02 grain of lead per pound of fruit. No justification is seen for the application of lead-bearing sprays to vegetables, and no tolerance for lead on vegetables is recognized.

The employment of fluorine sprays as substitutes for lead and arsenic also necessitates a tolerance for fluorine as a means of safeguarding the consumer. A tentative tolerance of 0.01 grain of fluorine per pound of fruit was also announced on June 20. Rapid and accurate methods for fluorine determinations were devised by the Administration chemists to cope with this new problem.

It cannot be anticipated that spray-residue activities will slacken in the near future. Until methods for combating insect pests are developed which do not depend upon the treatment of growing foods with poisonous sprays, it is to be supposed that fruit- and vegetable-producing areas will continue to require attention. Growers, however, are realizing more fully than ever before the actual menace to health involved in the presence of residual poisons on fruits and vegetables and are adopting methods, both by the control of spray schedules and by the use of proper cleansing methods, to bring their products to an acceptable state of purity.

During the last year 241 seizures based on excessive residues were made as follows:

Apples	137	Currants	8
Cauliflower	54	Crab apples	7
Celery	18	Cabbage	2
Pears	12	Cherries	3

Apples continue to require major attention, as is to be expected when the extent of the interstate traffic in this commodity is considered. On the other hand, cabbage, which in the loose-leaf variety showed an alarming amount of poisonous residue, necessitating 40 seizures in 1932, was found in general to be in excellent condition as a result of precautions adopted by the growers in sections previously employing arsenicals in excessive quantities.

Next to apples, cauliflower shipments originating in Colorado and Long Island, N.Y., required most attention. The latter area began extensive interstate shipments for the first time during the last growing season. The flower head was not found to be excessively contaminated, but large quantities of poison were found lodged on leaves and stems. Investigation revealed an extensive use of these portions of the plant for food as a soup ingredient or as greens, and seizures were therefore necessary as a measure of public protection.

The consignments of celery seized originated in a comparatively limited area of California where reckless spraying with arsenicals had been carried on. In addition to the consignments libeled under the Food and Drugs Act, the State authorities required the washing and trimming of approximately 20 carloads of the crop before permitting its sale.

The situation is now far from alarming. As indicative of present conditions it may be stated that during the 8-month period between July 1, 1932, and March 1, 1933, which may be considered as covering the crop season of 1932, 3,775 samples of fruits of various kinds were collected and examined. Of this number 280, or slightly more than 7 percent, contained arsenic in excess of the world tolerance of 0.01 grain per pound. From these figures it cannot be concluded that 7 percent of all fruit produced would show arsenic in excess of the established tolerance. It is utterly impossible for the force of the Food and Drug Administration to examine all shipments that move in interstate commerce. It therefore becomes necessary to exercise a selective system designed to apply intensive sampling to those shipments that may contain excess residue. For this purpose extended investigations are carried out in most producing regions to ascertain the spray schedules used, the efficacy of cleaning methods applied, and other factors that may influence the spray-residue content of the fruit when it is shipped. The sampling of interstate shipments is then directed mainly to lots that these observations indicate may contain excessive residue. We thus conclude, as the result of extensive experience, that considerably less than 7 percent of all interstate shipments of fruit exceeds the world tolerance, and that most of these are apprehended and seized before consumption.

Data on the selective sampling of apples during the 8-month period show that less than 3.9 percent of the samples contained from 0.01 to 0.019 grain of arsenic trioxide per pound; approximately 2.1 percent, from 0.020 to 0.029; and approximately 0.6 percent, from 0.030 to 0.039. Approximately 0.4 percent was above 0.039, ranging up to 0.080 as the highest found in a single sample of apples. Regulatory action by seizure was, of course, directed against the fruit bearing high residue.

Pears contained arsenic comparable in quantity to that found on apples. Peaches and cherries are rarely found to contain more than 0.01 grain per pound.

Approximately 1,600 samples of vegetables were examined during the same season. Ninety-nine of these, or approximately 6 percent, were above the tolerance for arsenic. Use of arsenicals on vegetables is confined to restricted areas and is not nearly so wide-spread as their use on apples. With the exception of these restricted areas, vegetables are comparatively free from arsenic. It has been necessary to take legal action, as already indicated, against shipments from these sections of cabbage, cauliflower, and celery containing arsenic in excess of the tolerance.

The seizure of 48 barrels of vinegar, shipped by a New York State firm to a chain store in Pittsburgh, represents an unusual type of violation involving arsenic and illustrates the indifference of some food purveyors to health hazards. The product had been put up in barrels originally used for shipping white arsenic. Analyses of samples of the vinegar showed that some barrels of the product contained as much as 0.035 grain of arsenic trioxide per pint.

One of the most serious limitations of the present law, of especial moment where public-health questions are involved, is the lack of control over insanitary practices in food-manufacturing plants. Jurisdiction under the Federal statute exists only after a product has been shipped or offered for shipment within the scope of the law. The detection of insanitary practices through inspection in the manufacture of food products does not give sufficient warrant for removing offending goods from interstate channels. To obtain evidence of contamination that will warrant a charge of adulteration within the meaning of the law, it is necessary to collect representative samples of the product and analyze them. This is by no means always an easy matter. Analytical methods have not been developed with that degree of refinement needful to establish in all instances evidences of insanitary handling of a product originating in an insanitary factory.

The difficulties of the situation, as well as the public-health hazards involved, are well illustrated by the conditions in the fresh-crab-meat industry, particularly on the shores of Chesapeake Bay, in Maryland and Virginia. Fresh crab meat furnishes a particularly favorable medium for bacterial growth. A polluted product that may appear entirely sound to the casual observer may occasion distressing illness. Despite repeated efforts in previous years on the part of the Food and Drug Administration and appropriate State authorities to create a recognition of the need for sanitary precautions in the preparation of this product, distinctly unhygienic conditions continued to prevail. During the summer of 1932 an intensive sanitary resurvey of establishments packing crab meat was undertaken with the cooperation of the Virginia and Maryland authorities. Drastic recommendations for reforms in sanitary practices were offered. These recommendations were emphasized by the collection of more than 300 samples, representing consignments already in interstate traffic or about to be shipped.

Bacteriological examination of these consignments was rapidly made, and where a polluted condition was revealed seizure action was inaugurated. A total of 41 seizures was made. All of the packing establishments in the district, nearly 100, were inspected, most of which were found to be in an unsatisfactory condition, varying in degree and kind. This campaign resulted in a material improvement, but experience has shown that such improvement is likely to be sporadic unless continued surveillance is maintained during the active shipping season. A more effective plan for handling this situation is provided in the proposed food and drug bill.

A number of alleged food-poisoning cases are invariably reported to the Administration in the course of the year. These are always investigated for the purpose of determining the causative agent if there is any evidence whatever that the illness may be from food from an interstate source. It is a coincidence that, as in 1932, 18 such cases were investigated; 3 involved gastro-enteric disturbances, attributed to products which investigation showed had not been shipped subject to the act; 14 other instances reported yielded on laboratory examination of the suspected food no positive evidence of food poisoning. The causative agent in the one positive case investigated was smoked sausage packed in oil, which occasioned an outbreak of food poisoning in North Dakota in the summer of 1932. The sausage was dispensed at the retail store from a large opened can. A sample of the sausage examined in the laboratory was found to contain *Salmonella Schottmulleri* (*Bacillus paratyphosus* B). This organism is occasionally associated with food poisoning, particularly from meat. A careful review of the inspection evidence indicated rather clearly that contamination of the sausage with this organism occurred at the retail store. A similar case of sausage poisoning was mentioned in last year's report. These instances emphasize the importance of heeding the warning, which now invariably accompanies the label, that the product after opening shall be kept under adequate refrigeration.

FOOD ADULTERATIONS INVOLVING FILTH AND DECOMPOSITION

Supervision of fresh and canned fish occupies a material proportion of the Administration's energies under this classification. In the case of fresh and frozen fish the presence in the flesh of two species, namely, the mongrel whitefish, or tullibee, and the ordinary whitefish, of a parasitic worm of particularly repul-

sive character renders the product filthy within the meaning of the statute. As will be later reported in a discussion of outstanding court actions during the past year, the courts have upheld the contention of the Administration that this type of parasitic infestation constitutes an adulteration. Forty seizures of infested fish were made during the fiscal year, as compared with 105 seizures during 1932. The reduction in the number of seizures does not indicate a reduced infestation. Rather, it demonstrates that shippers of these fish obtained from both domestic and Canadian waters have recognized the illegality of the practice of shipping the product and have either refrained from making shipments or are taking precautions, by the examination of comprehensive samples, to determine that the fish is in satisfactory condition before offering it in commerce. In 1932, 90 percent of the samples collected were found to be in violation; in 1933, 30 percent were in violation.

It is a regrettable fact that there appears to be no prospect of correcting this infestation at the source. The tullibees in some of the large inland bodies of water, like Lake Winnipeg, Canada, and Lake of the Woods, Minn., are heavily infested. Apparently the only way that the public can be protected against this type of adulteration is to refrain from catching the heavily infested types for food purposes or, in the case of the more lightly affected varieties, to adopt some method of representative sampling and inspection to determine the fitness of a consignment for food use before it is packed for shipment. One of the seizures of tullibees during the year totaled 95,000 pounds. The fish were shipped from Minnesota to a cold-storage warehouse in Baltimore, to be smoked and sold to consumers in the Middle Atlantic States.

The salmon pack of 1932 approximated 5,867,590 cases and included some of the worst fish encountered in recent years. The large run experienced was undoubtedly the primary cause; canneries apparently could not handle the volume of fish received. With a defective inspection program in the canneries for the removal of bad fish, the result was the packing of a large quantity of objectionable material. Of 116 canneries given attention by our Seattle Station, the product of 29 was found to be in violation. Thirty-four percent of the official samples examined were found actionable. In addition to 695 official samples, more than 400 informal samples were also examined. One hundred and seven consignments were seized and 77 recommendations for prosecution transmitted to the Department of Justice. Surveillance of the canned-salmon pack will continue to be a major project of the Food and Drug Administration. A satisfactory pack is put out by a majority of the canners, but the practices of the minority will apparently continue to require regulatory attention. After so many years of regulatory operations directed at the salmon-canning industry, it should not be necessary to institute annually such a large number of seizure and prosecution actions.

Extensive sampling of canned tuna and canned sardines reveals that these products continue in good condition so far as the domestic pack is concerned. However, importations of Japanese canned tuna are frequently found to be distinctly objectionable. Two hundred and fifty-one samples, totaling 13,379 cans, were collected from import shipments, and numerous consignments were refused entry because of the presence of decomposed fish in a large proportion of the cans.

While some improvement is noted in the character of the canned shrimp put up in the southern part of the United States, conditions are still far from satisfactory. Nineteen consignments were seized and 17 criminal prosecutions recommended because of shipment of this commodity in a decomposed condition, as compared with 33 seizures and 4 prosecutions in 1932. Most of the prosecutions recommended in 1933 were based on shipments made in 1932, on which seizure action was inaugurated during that year.

Maine-canned blueberries were heavily infested with maggots some years ago, but are now in a commendable condition. The output of 20 packers, all of those in active operation, was carefully inspected and shown to be unadulterated. A deplorable outcome of this condition, however, is that the blueberries rejected by the canneries because of excessive worm infestation are now diverted to interstate commerce for consumption as fresh berries. As a result, it has been necessary during the year to seize 30 consignments of fresh blueberries, largely offered for sale in New York and other eastern markets. Continued surveillance over fresh blueberries to prevent the distribution of wormy fruit is necessary. It is entirely practicable by employing proper cultural and spraying methods to produce a satisfactory blueberry crop.

Marked improvement is shown in the condition of interstate traffic in rabbits. Only 1 seizure was made in 1933, as compared with 26 in 1932.

The improvement in the quality of dressed-poultry shipments reported last year continues.

Fresh and dried eggs continue in good condition and require little regulatory attention. This cannot be said of frozen eggs, however. Twelve seizures were recommended in 1933, and 19 criminal prosecutions were submitted to the Department of Justice. In 1932, 16 seizures of this commodity were instituted and 29 recommendations for prosecution submitted. One of the largest seizures of canned frozen eggs in the history of the enforcement of the Federal Food and Drugs Act was effected on November 22, 1932, when the Government libeled twenty-three thousand 30-pound cans, valued at approximately $100,000. The eggs were partly decomposed, and for this reason adulterated. The product was consigned by a Chicago shipper to a company in Jersey City.

BACTERIOLOGICAL EXAMINATIONS

Specialists of the Administration each year examine numerous samples of food suspected of decomposition, insect infestation, or filth. Such samples are subjected not only to the scrutiny of the chemist and the microscopist but also to careful bacteriological test. Table 3 gives some idea of the character of a number of the bacteriological and organoleptic examinations. In many instances these samples were subjected also to chemical analysis.

TABLE 3.—*Samples examined bacteriologically, organoleptically, or both, fiscal year ended June 30, 1933*

Product	Import		Domestic		Total	
	Samples	Containers	Samples	Containers	Samples	Containers
Acidophilus preparations	0	0	2	4	2	4
Dairy products	0	0	19	51	19	51
Fish and shellfish	287	15,959	246	13,331	533	29,290
Fruits and vegetables	25	339	132	2,067	157	2,406
Water	29	140	52	200	81	340
Sutures and ligatures	0	0	49	1,119	49	1,119
Ampul solutions	0	0	6	81	6	81
Miscellaneous	3	43	8	208	11	251
Total	344	16,481	514	17,061	858	33,542

FOOD VIOLATIONS INVOLVING CHEATS

A legislative standard for butter was enacted by Congress in 1923. It established a fat content for this product of 80 percent allowing for all tolerances. Butter is the only food for which a legal standard has been fixed by Congress. The annual consumption of creamery butter amounts roughly to 1½ billion pounds. Relatively small deviations from the standard or from the declared weight would entail, in the aggregate, an enormous economic loss to the purchasing public if uncontrolled. Interstate butter traffic, therefore, is subjected to extensive surveillance. During the 12-month period, 151 shipments found to be low in butterfat, short in weight, or both, were libeled, and 185 criminal prosecutions instituted against shippers of illegal butter. The number of violations encountered continues about the same, although the extent of the variation from the legal standard or declared weight is less than in previous years. The courts in some jurisdictions have shown a disposition in the case of prosecution actions to impose materially heavier penalties than heretofore. This may be expected to result in improved conditions. Unfortunately, in several other important producing districts the courts have manifested an unwillingness even to permit the institution of prosecutions or else have imposed penalties so low as to be without corrective effect. The result is that continued shipment of illegal butter from these areas is to be anticipated. It will be necessary to give extended attention to this product until decided improvement is shown.

Another dairy product, cheese, continues to require regulatory actions because of low butterfat and excessive moisture. Fourteen seizures and nine criminal prosecutions were instituted.

Although no specific fund for the enforcement of the McNary-Mapes amendment to the Food and Drugs Act has been appropriated, the sum of $12,389 was alloted by the Administration for this purpose from its existing funds. Surveys

were made of packing plants putting up canned peas, tomatoes, peaches, and other canned foods for which standards of quality, condition, and fill of container have been established. The year's experience indicated that canners were processing overmature peas to the point where they would meet the tenderness requirement of the existing standard. The turbidity of the liquid was increased by this treatment, but not beyond the point reached in large containers of peas of satisfactory maturity. After appropriate investigation, an additional requirement for maturity was incorporated in the standard, limiting to 25 percent, by count, peas which are so mature as to swell and rupture the skin during canning operations. It is anticipated by the Administration that this change will do away with the abuse attendant upon processing overmature peas to the point mentioned.

A preliminary study was made of the application of the 90 percent fill requirement, established under the amendment, to certain sirups with a tendency to liberate large quantities of gas, even though the product is free from any fermentation. Sixty shipments of canned foods, totaling approximately 9,000 cases, and including cherries, apricots, peaches, pears, peas, and tomatoes, were found to violate the provisions of the amendment and were seized. This range of canned goods covers all products for which quality standards have so far been promulgated.

Cooking and salad oils continue to require attention. Twenty-four seizures and nineteen prosecutions were instituted. The common offenses are short volume and misbranding to imply a superior type of oil.

ACTIONS ON DRUGS

In spite of definite improvement in the manufacture, storage, and sale of medicinal products, the Administration continues to devote a great deal of attention to interstate and foreign traffic in these commodities. Grossly misbranded and worthless patent medicines recommended for the cure or treatment of serious diseases are still to be found on the market. These preparations are usually of limited interstate sale and are promptly withdrawn from the jurisdiction of the law when legal action is instituted, only to be followed by another crop equally worthless under new names but with similar extravagant claims. Constant vigilance is required to control this illicit traffic. During the 12-month period, 439 seizures of products of this type were made, including 74 veterinary preparations. Three hundred and seven criminal actions were initiated. The new food and drugs bill, to be discussed later, affords far more effective means for the control of this traffic than now exists.

The importance of extending the provisions of the law so as to exact the same standards of honesty in the advertising of drugs that are now required in labeling is perhaps nowhere better illustrated than in the case of antiseptics. Advertising claims setting forth the marvelous preventive and curative properties of antiseptic solutions in not a few instances exceed all bounds. Label claims and the representations made in circulars enclosed in the interstate package are, as a rule, far more conservative because such statements are subject to the prohibition in the present law against untruthful representations. Products claimed to have antiseptic properties are promptly sampled and analyzed as soon as they appear on the market. When label claims are found to be false, misleading, or fraudulent, legal action follows. This does not prevent a continuation of the misleading claims in collateral advertising but at least guarantees labels free from misleading claims. A careful purchaser may acquire enlightening information by making a comparison of the label statement and the more enthusiastic claims made for the preparation by means of advertisements. Three hundred and ten shipments of so-called antiseptics were sampled and analyzed during the year, resulting in 69 legal actions.

The routine surveillance of anesthetic ether was continued. During the last quarter of the year 625 cans were examined. Every can met the United States Pharmacopoeia requirements as to purity. These samples were the output of the four manufacturers who are the sole remaining producers of anesthetic ether. All have adopted procedures worked out within the last few years designed to prevent or check deterioration of the ether after packing. Manufacturers who have been unable to accomplish this have ceased to market anesthetic ether. During the entire year it was necessary to libel only 8 shipments of ether, as compared with 19 the preceding year.

Last year's report referred to the resurvey of United States Pharmacopoeia and National Formulary drugs, undertaken toward the close of the fiscal year. While about 1,600 samples had been collected up to that time, analyses of only a small proportion of them had been completed. The results showed a satisfactory degree of compliance with the standards. The work was completed in 1933. The outcome did not substantiate the earlier indications of a generally satisfactory condition. Of the 2,922 samples collected and analyzed (2,349 pharmacopoeial and 573 Formulary), 352, or 12 percent, were substandard and were the subject of legal action.

The substandard products included a number of articles known to deteriorate with age. In such cases action was brought by seizure of the goods where the stocks were available. In those instances in which so brief a period had elapsed between the time of shipment and the time of analysis as to preclude the possibility that deterioration had taken place after shipment, action looking to the prosecution of the shipper was instituted.

In some of the preparations, such as liniments, excess proportions of certain ingredients and corresponding deficiencies in others were found.

Some of the pharmaceutical chemicals, such as glycerin and mineral oil, were found not to have been refined to the degree required by the official standards.

In the manufacture of preparations of crude drugs, such as tinctures and fluid extracts, lack of proper control on the part of the manufacturer appears to have been responsible for a number of the violations found.

Some of the violations in drugs resulted from the use by the manufacturer of official titles for products prepared according to private formulas. This tendency was noted particularly in the preparations sold under National Formulary titles.

Very few, if any, instances of deliberate, intentional adulteration were discovered.

While the number of United States Pharmacopoeia preparations on the market exceeds the National Formulary products, this survey showed that a smaller proportion of the former is in contravention of the law. Slightly more than 9 percent of the United States Pharmacopoeia products examined were substandard as compared with about 23 percent of the National Formulary articles. Obviously this field requires persistent and continuous attention by the Administration.

For a number of years the Administration has consistently collected samples of interstate shipments of alleged radioactive preparations. These, if actually radioactive, are potent for serious injury unless administered under the most careful medical supervision. If not radioactive, they are worthless and therefore also dangerous because they may lead a sufferer from disease to neglect effectual methods of treatment. Exclusive of commercial mineral waters, which occasionally bear claims for radioactivity, 34 interstate shipments of alleged radioactive products were sampled during the year, as well as 18 import shipments. Samples consisted of ampuls, creams, ointments, suppositories, soap, tablets, mouth washes, salts, pads, compresses, and emanators, or other devices alleged to be capable of making water slightly radioactive. In the case of domestic products, 20 warranted some form of legal action. Almost invariably the labels bore false and fraudulent therapeutic claims as well as false statements regarding the radioactivity of the article. Of the 18 import shipments sampled exportation was required of all but 4, in which the misbranding was such that relabeling would bring the product into compliance with the statute.

Late in the fiscal year a comprehensive investigation of the sterility of ampul solutions for intravenous injection was started. The work was stimulated by a report in a scientific publication of a limited investigation indicating the possibility that such solutions were nonsterile. The work is still under way, but up to the present time 81 separate ampuls have been examined and in no case has unsterility been disclosed. This survey will be continued until the field has been comprehensively covered.

The testing of foods and drugs, represented as having vitamin potency was continued. As pointed out last year, these studies are time-consuming as compared with other routine methods of analysis. In the course of the year the laboratory tested 18 different products purporting to contain one or more of the vitamins. Nine of these gave ground for legal action.

Three hundred and seventy-six biological assays of drugs and drug preparations were made during the year. These examinations are summarized in tables 4 and 5.

TABLE 4.—*Biological assays of imported crude drugs, fiscal year 1933*

Article	Samples examined	Samples requiring detention and exportation
Aconite	5	1
Digitalis	32	0
Ergot	49	1
Strophanthus	5	0
Total	91	2

TABLE 5.—*Biological assays of domestic drug preparations, fiscal year 1933*

Article	Samples examined	Samples requiring action
Aconite	37	9
Digitalis	105	8
Epinephrine	11	0
Ergot	105	16
Posterior pituitary extract	22	2
Squill	4	2
Strophanthus	1	0
Total	285	37

Among the so-called livestock and poultry remedies removed from the market were "vitamized compounds," contagious abortion "cures," mineral mixtures, and preparations recommended for the elimination of worms in livestock or poultry, and numerous other drug preparations falsely and fraudulently labeled as useful in the treatment of livestock and poultry maladies.

ANALYTICAL AND SAMPLING METHODS

The Administration carried on, during the year, a number of significant studies with a view to working out analytical and sampling methods for foods.

A study is now under way of the bacterial flora of decomposed shrimp, the objective being to determine the source and significance of the various bacteria found in some packs of the sea food. The Administration is also studying the organisms that have been isolated from sour or mushy canned shrimp with the same end in view. As a result of the study of the improved method for discriminating between fecal colon organisms and nonfecal types, the Administration is now able to proceed much more expeditiously in the laboratory examination of crab meat, bottled water, and other foods, or beverages. A study of the various cocci forms that cause food poisoning is also under way. As soon as facilities are available for the purchase and proper housing of experimental animals, this work can be pushed to completion.

The investigation of dried-milk products referred to in the last report is now in the laboratory stage. Samples prepared under known conditions are in course of study for the purpose of devising objective methods of proving decomposition. So far, extreme difficulty has been encountered in an attempt to correlate factory observations with the results of objective analyses.

The work on methods for the estimation of various organic acids in foods has been continued. Such perfected analytical procedure is a necessity in establishing many kinds of food adulterations. Methods for determining inactive and active malic acid in foods, and citric and lactic acids in milk products and other foods have been offered for publication.

A method for the identification of gamma-undecalactone, widely used in imitation peach and apricot flavors, has been devised and published. Two articles on the detection and determination of beta-ionone, used in imitation raspberry flavors, have been prepared for publication. A second paper on the systematic identification of flavoring constituents, entitled, Detection and Qualitative Separation of Classes, has been published. This work on imitation fruit flavors is a continuation of that mentioned in last year's report.

FOOD STANDARDS

The Food Standards Committee held one meeting during the year. New and revised standards were recommended (and approved by the Secretary of Agriculture, May 12, 1933) for apple butter, evaporated apples, dried apricots, dried peaches, dried prunes, oil of lemon, macaroni, semolina macaroni, farina macaroni, egg noodles, and plain noodles.

The committee held a number of hearings for the purpose of considering proposed definitions and standards for egg products, molasses, and alimentary pastes.

CERTIFICATION OF COAL-TAR COLORS

In the routine examination of food colors to determine their compliance with the requirements of the pure food law, 1,039 batches, representing the output of 43 firms, were certified. Two of these firms were new certifiers. Straight dyes (not including repacked colors), amounting to 181,486 pounds, were certified during the year. Fifteen thousand, two hundred and thirty pounds of repacked straight dyes and 333,675.33 pounds of mixtures also were certified. Nine batches of straight dyes, 3 of repacked straight dyes, and 11 of mixtures were examined and rejected.

IMPORTANT COURT CASES

One of the outstanding cases on patent medicines contested during the year was that against the shipper of Banbar, an alleged diabetes remedy put out by a Pittsburgh, Pa., manufacturer. Banbar is composed essentially of a liquid extract of the common weed horsetail, and retails at $12 per pint. The Government alleged that the label representations to the effect that the article is a treatment for the serious disease, diabetes, were false and fraudulent. To establish the falsity of the claims medical experts, skilled by long experience in the treatment of diabetes, testified on behalf of the Government that the nostrum was worthless for this disease. The Government also introduced a number of death certificates of victims who had relied upon Banbar for treatment and who had died of diabetes. Some of these individuals had written testimonial letters to the manufacturer a year of so before they died, announcing that Banbar had been successful in remedying their malady. Despite such convincing evidence of the utter worthlessness of the nostrum, and the fact that reliance upon it instead of rational treatment was bringing many persons to untimely death, the Government was unable to establish fraudulent intent on the part of the manufacturer, and the jury rendered a verdict in his favor. Enactment of the new food and drugs bill (S. 1944) to be discussed later will remedy this serious defect in the law.

Another important trial concluded during the year brought to terms the ring of bootleg "ginger jake" peddlers whose indictments were noted in the last report. These men had shipped consignments of a poisonous imitation of extract of Jamaica ginger. They labeled the barrels simply as "Liquid Medicine." Hundreds of cases of paralysis followed the consumption of the spurious extract. Evidence showed that most of the victims had used the poisonous Jamaica ginger as an intoxicant, although a few apparently used it for medicinal purposes. Because the traffic had been carried out through the underground channels characteristic of the bootleg business and the method of operation was thus so well concealed, it took more than 2 years of continuous and highly intensive investigation on the part of members of the Food and Drug Administration to unearth the facts leading to the successful court action.

The evidence finally showed that a conspiracy had existed between at least three men to ship the adulterated stuff. The penalties for violating the conspiracy law are very much heavier than those for violating the Food and Drugs Act, under which prison sentences could not have been imposed and only nominal fines levied. It was decided, therefore, to bring the action as an allegation of a conspiracy to violate the Food and Drugs Act. The three men convicted were given jail sentences ranging from 17 to 20 months, and fines of $2,500 each were imposed on two. The defendants appealed the case to the Circuit Court of Appeals, which confirmed the judgment of the lower court.

The wholly unscientific background for the claims made for some patent medicines is illustrated by the Anti-Phymin case against the manufacturer tried during the last fiscal year in the Federal Court of Pensacola, Fla. Anti-Phymin was nothing more than water which had been exposed to the fumes of burning sulphur and had thus taken some of the fumes into solution. It is well known that sulphur fumes exert a preservative effect and prevent to some extent the fermentation of food products. The manufacturer claimed that all disease is caused by fermenta-

tion and that by taking his medicine, fermentation in the human body would be stopped. Therefore, he contended, his medicine was an effective remedy for tuberculosis, diabetes, and many other serious conditions. In this instance the Government was able to prove both falsity and fraud to the satisfaction of the Federal jury and the manufacturer was sentenced to pay a fine of $400. The sentence was suspended for 2 years, conditioned upon the good behavior of the defendant.

An important case under the McNary-Mapes amendment to the act developed during the last year as a result of numerous seizure actions against canned soaked dry peas put out by an Indiana canner. The McNary-Mapes amendment authorizes the Department to establish standards of quality and condition for canned foods. The standard established for canned peas under this authority defines the product as consisting of tender, immature peas, and sets up certain quality factors. Peas that fail to meet these requirements, so the Administration holds, are substandard and must be labeled as such under the regulations. Canned soaked dry peas consist of peas that have been allowed to mature and dry in the field. They are prepared by soaking them in water prior to canning. Their quality is lower than peas harvested and canned while they are still immature and succulent. The seizures were brought on the allegation that the soaked dry peas were substandard in quality and not so labeled. The packer brought suit for an injunction against the United States attorney at Indianapolis to restrain that official from the enforcement of the Food and Drugs Act as interpreted by the Department. The court held that the Department's standard was invalid and granted the injunction. The Government has taken an appeal from this decision. Since the jurisdiction of the Indiana court does not extend to the official residence of the Secretary of Agriculture, in the District of Columbia, the canner brought a similar action in the courts of the District. The court granted a preliminary injunction on the ground that the regulation is probably invalid. The Department has filed an answer, and the case is now awaiting trial on the issues. These restraining orders apply only to the output of the Indiana canner who brought the actions.

On February 1, 1933, a jury of the Federal Court for the Eastern District of Louisiana gave a verdict for the plaintiff in a seizure action the Government had brought against several hundred cases of tomato paste. The Government's allegations were that this tomato product had not been concentrated sufficiently to entitle it to be labeled "Tomato paste." Fresh ripe tomatoes normally contain about 95 percent of water and it is the Department's view, which is supported by the better elements of the canning industry, that tomato paste should be prepared by straining and concentrating tomatoes until the water content is not more than 78 percent. In fact, the Department has issued an administrative standard for tomato paste requiring that it contain not less than 22 percent of the solid material of tomatoes. The Government lost the case primarily because of the fact that aside from the standards of quality authorized under the McNary-Mapes amendment, and the one legislative standard—that for butter—there exists no legal authority for the establishment of standards for food products.

Another case in which the absence of legally enforceable standards resulted in failure of the Government to protect the public against cheat was that tried in the Federal District Court for the Eastern District of New York against a firm for the shipment of oysters to which, the Government alleged, water had been added. At the termination of the proceedings the court stated in brief that he understood some washing of oysters was necessary and that the inclusion of some water in the oysters inevitably followed washing, but that he could not see any standard for determining when the amount of water became excessive. The court condemned the practice of cheating the public by selling water at oyster prices, but declared that since there is no established standard for water in oysters, he could not find for the Government. The case was dismissed.

An interesting case, the first of its kind in the history of the pure food and drugs law, was tried during the year in the Federal Court at New York City. The Government had banned the sale of large stocks of worm-infested tullibee fish. The parasites in the fish, while not dangerous to human health, are decidedly revolting in appearance. The court returned a verdict for the Government with an opinion to the effect that "while the statute is primarily concerned with the health of consumers, it might well ban 'filthy' or 'decomposed' animal matter or the product of a diseased animal without direct or scientific proof of danger to health." It was the opinion of the court that the aesthetic guide frequently precedes the scientific one and that the Government might wisely ban food which runs counter to that guide in the categories mentioned. "The fact that most consumers would not discover the worms and would, therefore, not have their

feelings affronted is of no consequence", the court continued, "because were it otherwise the statute would not be needed." The court also declared that it was his opinion that the statute is largely intended to protect those consumers who would not be in a position to observe the defect in the food.

One Supreme Court decision under the Food and Drugs Act was rendered during the year, that upholding the constitutionality of the so-called net-weight amendment. This decision followed the indictment of the Shreveport Grain & Elevator Co., of Shreveport, La., charging interstate shipment of corn meal misbranded in that the packages were short of the declared weight. The District Court for the Western District of Louisiana had sustained the claimant's contention that the net-weight amendment was unconstitutional. The Supreme Court, however, reversed this conclusion.

THE NEW PURE FOOD AND DRUGS BILL

Demand for a complete overhauling of the outworn mechanism of 1906 received a new impetus during the year through the interest of the President of the United States and the sympathy and cooperation of the Secretary and Assistant Secretary of Agriculture. A bill to supplant the present measure was drafted in the Department, reviewed and approved by the Department of Justice, and introduced in the Senate on June 12, by Senator Royal S. Copeland, of New York, as S. 1944.

The new draft preserves all of the worthy features of the present law. Its principal additional features are as follows:

1. Cosmetics are brought within the scope of the statute.
2. Mechanical devices intended for curative purposes, and devices and preparations intended to bring about changes in the structure of the body are also included within the purview of the law.
3. False advertising of foods, drugs, and cosmetics is prohibited.
4. Definitely informative labeling is required.
5. A drug which is, or may be, dangerous to health under the conditions of use prescribed in its labeling is classed as adulterated.
6. The promulgation of definitions and standards for foods, which will have the force and effect of law, is authorized.
7. The prohibition of added poisons in foods or the establishment of safe tolerances therefor is provided for.
8. The operation of factories under Federal permit is prescribed where protection of the public health cannot be otherwise effected.
9. More effective methods for the control of false labeling and advertising of drug products are provided.
10. More severe penalties, as well as injunctions in the case of repeated offenses, are prescribed.

These added features are discussed below in the order in which they are presented.

1. The present law is wholly without jurisdiction over cosmetics, except in those rare instances when the labeling bears medicinal claims. While the majority of cosmetics are harmless, tragic occurrences have resulted from the unwitting use of products containing highly dangerous ingredients advertised and labeled as entirely harmless. No better medium of control and consumer protection exists than the Food and Drugs Act. It is logical to extend the provisions of the statute to cover cosmetics. As an example of the type of product which would be contraband under the amended statute, the depilatory known as "Koremlu Cream" may be cited. This product, represented as entirely harmless and actually beneficial to the skin, contained a highly poisonous chemical—thallium acetate. Its widespread utilization for the removal of superfluous hair caused many cases of severe injury to users before the manufacturer was forced into bankruptcy by accumulation of damage suits. The Federal Government, lacking legal authority to control cosmetics, was unable to give the consumer the protection which should have been afforded.

2. Mechanical devices, represented as helpful in the cure of disease, may be harmful. Many of them serve a useful and definite purpose. The weak and ailing furnish a fertile field, however, for mechanical devices represented as potent in the treatment of many conditions for which there is no effective mechanical cure. The need for legal control of devices of this type is self-evident. Products and devices intended to effect changes in the physical structure of the body not necessarily associated with disease are extremely prevalent and, in some instances, capable of extreme harm. They are at this time almost wholly beyond the control of any Federal statute. As a striking illustration the product

Marmola may be cited. It is a "slenderizing" compound. It is not a drug within the present terms of the Food and Drugs Act, since that law defines a drug as a substance or mixture of substances intended to be used for the cure, mitigation, or prevention of disease. Marmola, however, is capable of seriously injuring the user. The new statute, if enacted, will bring such products under the jurisdiction of the law.

3. The terms of the present Food and Drugs Act are not applicable to advertising statements relating to foods, drugs, and cosmetics. There has been a too common practice in some quarters to meet literally the requirements of the Food and Drugs Act as to the honest labeling of products subject to its jurisdiction, but to allow imagination full play in devising advertising designed to entice the consumer. The need for control of serious abuses in the advertising field has long been recognized by the public, by ethical manufacturers and advertising specialists. Appreciating its lack of control over advertising under the present Food and Drugs Act, the Food and Drug Administration several years ago began a series of educational broadcasts, and at the same time published articles in various journals, designed to encourage the intelligent reading of labels. It recommended that the more conservative label claims on products subject to the act be accepted at face value rather than the extravagant representations made in advertising. The campaign was not without effect. A very natural reaction, however, was a demand on the part of consumers and interested persons generally that legal control of advertising be inaugurated. Under the new bill the label provisions of the law will apply also to all forms of advertising, the responsibility for the truth of such statements being the manufacturer's, not the publisher's.

4. The present statute is largely negative in its requirements as to labeling. It provides not for what must be stated upon the label but for what must not appear thereon. It prohibits false and misleading statements, but does not insist on positive and informative statements except as to declarations of the quantity of contents on foods in package form and certain other very limited specific declarations. Following the inauguration of the read-the-label campaign there was a natural reaction on the part of consumers by way of a demand for more informative labels. The consumer pointed out that intelligent buying is difficult, if not impossible, unless labels are required to carry enlightening information as to the composition and character of a product. Under the new bill provision is made for disclosure on the label of sufficient facts to enable intelligent and discriminating buying—a requirement that will operate unquestionably to the advantage of the consumer and the responsible manufacturer.

5. Practically all drugs are dangerous if not properly administered. Prohibition of traffic in dangerous drugs would rule most legitimate medicinals off the market. Certain products having distinct physiological effects and unquestionably to be classed as drugs are so potent for harm if indiscriminately administered that there can be no excuse for their unrestricted distribution to the consuming public. A solution of radium known as "Radithor", responsible a few years ago for the untimely death of a prominent citizen, is illustrative of this type of objectionable drug product. The article, in spite of its highly dangerous character, was wholly legal under the present statute. It was labeled precisely for what it was and bore no false or fradulent therapeutic claims. Its unrestricted sale was distinctly against public interest. It should have been possible, but was not, for the Government to have prohibited its sale. The Food and Drug Administration had published repeated warnings about the danger of such products. It could go no further under its legal powers. The new bill prohibits traffic in any drug product of this type which is, or may be, dangerous to health under the conditions of use prescribed in the labeling thereof.

6. The present law gives the Department of Agriculture no authority to establish legal standards for food products, except in the limited field of canned foods. The food standards announced by the Department are wholly advisory in character and compliance is a voluntary matter on the part of the manufacturer. Such advisory standards are based upon the consensus of consumer understanding and upon good manufacturing practice. To prove that a product sold within the jurisdiction of the Food and Drugs Act and that fails to comply with the advisory standard is adulterated or misbranded, it is necessary for the Department to present to the court and jury convincing evidence that the advisory standard does represent the actual composition of the product expected by the consumer and recognized by the majority of the trade. Proof that the food on trial does not meet the advisory standard is of no avail unless the validity of the standard is first established. This imposes a double burden of proof upon the Government as well as the expense of bringing into court trade and consumer witnesses who are

prepared to testify that the advisory standard accurately represents the material in question. It has long been recognized that this necessity imposes a handicap of undue proportions upon the Government and that the lack of legal standards is a distinct disadvantage to ethical manufacturers who are forced to compete with products which differ from the advisory standards. The establishment of food standards having the force and effect of law will vastly simplify the problem of enforcement and will unquestionably be of great advantage to the consuming public and to the manufacturer of legal products.

7. A complete elimination of all poisonous substances in foods is in some instances impossible. Where the presence of poisons is unavoidable their quantities must be kept so low that by no possibility will the food be harmful to the user. Where they may be dangerous in any quantity they should be absolutely prohibited. The present statute contains no provision authorizing either the complete prohibition of traces of poison in foods or the establishment of tolerances for poisons. On the contrary, it imposes upon the Government the obligation of showing affirmatively in every instance that a food containing an added poisonous ingredient may be harmful to health under the conditions of use. The problem of establishing possible poisonous effects as a result of the consumption of minute quantities of poisonous ingredients in foods presents extreme difficulties. Without such proof a food containing an added poison cannot be condemned as adulterated. The Government is not permitted in establishing its case under the terms of the present statute to take into consideration similar poisons in other items of the diet, although these may contribute to the total intake of the poison and be an important factor in determining the relative harmfulness of the adulterant.

8. In an earlier part of this report reference is made to the unsatisfactory and dangerous sanitary conditions prevailing in crabmeat packing establishments. It is shown that a distinct consumer health hazard is involved but that authority does not exist in the present law to compel the packers to improve factory conditions. The Administration must confine its legal actions to seizure and prosecution if, and when, interstate shipments can be shown by bacteriological analysis to be definitely polluted. The difficulty of establishing proof of violation by objective examination has been pointed out. The new bill provides power to require manufacturers to operate in such instances under Federal permits. The issuance of such permits would be predicated upon the condition that proper sanitary control be maintained, and shipment without valid permit would constitute a criminal offense.

9. The present law defines a drug as misbranded if its label bears false and fraudulent therapeutic claims. This requirement imposes upon the Government the necessity of proving not only that the preparation will not have the curative or therapeutic effects claimed, but likewise that in making such claims the manufacturer was guilty of fraudulent intent, that is, that he had knowledge of the ineffectiveness of the product. It is a comparatively simple matter to prove through competent medical evidence that an extravagantly labeled medicine will not be effective in curing the disease conditions for the treatment of which it is offered. It is far more difficult to establish that in making such therepeutic claims the manufacturer did so with knowledge of their falsity.

In the Banbar case, already discussed, in which the Government unsuccessfully prosecuted the manufacturer of a preparation offered for the treatment of diabetes, outstanding medical witnesses testified to the entire ineffectiveness and worthlessness as well as the actually dangerous character of the product. The Government lost the case, however, primarily because it was unable to prove to the satisfaction of the jury that the manufacturer was aware of the worthlessness of the product. The manufacturer's intent in no wise ameliorates the damage sustained by the consumer of worthless medicines. The new measure proposes to eliminate the need for establishing the fraudulent character of false representations with regard to medicinal products, and instead holds a drug misbranded if its label bears any representation directly, or by ambiguity or inference, concerning the effect of the drug, that is contrary to the general agreement of medical opinion.

10. The present law establishes a fine of $200 as the maximum penalty for a first offense. In the recent convictions under the Food and Drugs Act of individuals responsible for the shipment of poisoned Jamaica ginger which paralyzed thousands throughout the country, the highest penalty that could be imposed was a $200 fine, a ridiculously inadequate sum. The present statute, in case of a second offense, provides for a fine not exceeding $300 or imprisonment for not exceeding 1 year. Chronic offenders under such conditions may readily regard a fine as merely a tax on continuing a profitable illegitimate business. The new bill imposes materially more severe penalties.

The bill retains the requirement of the present statute prohibiting traffic in foods that contain added poisonous ingredients that may render them injurious to health, or that may be filthy, putrid, or decomposed, or that may be debased by abstraction of some valuable ingredient or admixture with some substance reducing quality or strength. It retains the United States Pharmacopoeia and National Formulary as the standards for the drugs named in those authorities but strengthens and amplifies the existing provisions. It retains requirements for the declaration of certain habit-forming narcotic or hypnotic drugs in medicinal products and imposes the additional requirement that the label bear a warning statement that the product may be habit forming.

While the new bill has been introduced, its serious consideration by Congress must await the next session. It is a measure drafted for public protection. Its eventual fate will depend largely upon a manifestation of public interest.

INSECTICIDE ACT

The farmer, fruit grower, and truck grower have long recognized the necessity for using insecticides and fungicides on growing plants and the importance of seed treatment to combat the attack of destructive insects and fungi. There has been a great increase in recent years in the number and type of chemical products used for the control of insects and fungous diseases because of a recognition of the great economic loss resulting from the ravages of these pests and of scientific advance in methods for their control. The well-known fact that many diseases of man and animals are communicated by insects that can in many cases be successfully controlled by chemical agents has led to an ever-increasing demand for products to combat these insects.

The plan of enforcement of the Insecticide Act calls for particular attention to the major agricultural insecticides and fungicides, of which the arsenicals and the copper and sulphur fungicides are the most important. Close supervision of these products during the years in which the law has been in effect has kept these products to a high standard, and occasion for action against the conventional types of products seldom arises.

The extent of the field covered by the Administration during the fiscal year is shown concisely in the following tabulation. The samples listed were examined chemically, microscopically, bacteriologically, or by submission to field tests.

	Number of samples
Arsenate of calcium	45
Arsenate of lead, paste and powdered	89
Paris green	14
Bordeaux mixture and combinations of Bordeaux with arsenicals	102
Lime-sulphur solution and sulphur preparations	211
Lubricating-oil emulsions	42
Miscellaneous insecticide and fungicide preparations for agricultural use	39
Dips and disinfectants for use on animals	68
Fly sprays for animals	48
Preparations for lice and fleas on animals (including poultry) and chicken mites	91
Disinfectants, germicides, and bactericides	236
Sodium-hypochlorite disinfectants and related products	48
Preparations for the control of clothes moths	243
Preparations for household insects	50
Miscellaneous	118
Fraudulent preparations	20
Total	1,464

Fifty-nine cases representing alleged violations of the law were referred to the office of the Solicitor for the institution of criminal prosecution or seizure proceedings.

Samples were collected from 288 consignments of insecticides and fungicides offered for importation. Of these, 31 consignments were found to violate the provisions of the act and were denied entry.

MISCELLANEOUS PLANT INSECTICIDES

Many preparations containing derris and pyrethrum extracts have been found to carry very broad label recommendations for a large variety of destructive crop pests. Little information concerning some of these products is available. The Administration devoted considerable attention to these insecticides. The continuance of studies will necessitate an extensive amount of testing over a period of several years to properly observe variations that have a bearing on the results obtained.

HOUSEHOLD INSECTICIDES

Insecticides designed for the control of clothes moths, flies, and other household pests received much attention by the Administration during the past year. In general, the samples which bore claims for "moth proofing" were found effective against moths when properly used. Some, however, were ineffective under specific conditions. For example, some moth preparations are soluble in inorganic solvents and are consequently lost during dry-cleaning processes. Special attention was also given to the various cedar-oil preparations that are frequently sold for the control of moths. A large amount of basic data on the effect of various moth-control materials was obtained.

Household fly sprays also were carefully studied. These usually consist of a light mineral-oil base with pyrethrum extract or some other material toxic to flies. A lack of any reliable method for the quantitative chemical analysis of fly sprays renders difficult an appraisal of their real value.

VETERINARY INSECTICIDES

Investigations to determine the insecticidal value of hydroquinone are well under way. The insecticidal properties of various soaps also are under investigation with a view to obtaining information on which to base criticism of efficacy claims on preparations containing soap designed for use on animals.

DISINFECTANTS AND ANTISEPTICS

Investigational work to determine the reason for the marked differences between the phenol coefficients obtained by the Food and Drug Administration and the Rideal-Walker methods on certain samples of pine-oil disinfectants was conducted and the results described in a paper, The Influence of Certain Physical Factors in Disinfectant Testing with Particular Reference to Pine Oil Preparations, to be published in the near future.

CHEMICAL TESTS

Because of the great variety of new products appearing on the market each year the Administration is obliged to investigate analytical methods used in examining the materials. The Administration conducted studies of the method for the determination of selenium, and carried on an investigation of the Willard and Winter method for the determination of fluorine in products containing barium fluoride, barium silicofluoride, aluminum fluoride, sodium aluminum fluoride, and sodium aluminum silicofluoride.

The electrolytic method for the simultaneous determination of lead and copper in Bordeaux-lead arsenate, mentioned in last year's report, was studied in collaboration with the referee on insecticides and fungicides of the Association of Official Agricultural Chemists. Results obtained indicate that the method is worthy of adoption by the association.

Studies were also conducted for the purpose of the determination of pyrethrins in insect powder.

CAUSTIC POISON ACT

The Federal Caustic Poison Act requires that products covered by the statute, such as carbolic acid, lye, hydrochloric acid, etc., shall be labeled in such a manner as to protect the user by giving information as to the dangerous character of the chemicals. The statute provides, in general, that caustic or corrosive substances enumerated in the law, when put up in containers of a size for household use, bear conspicuous and easily readable labels, containing the common name of the substance, the name and place of business of the manufacturer, packer, seller, or distributor, the word "Poison" in letters of specified style and size, and directions for treatment in case of accidental personal injury.

About 85 percent of the many thousands of labels used in products coming within the law have been brought into compliance with legal requirements since the passage of the Caustic Poison Act. The products of approximately 1,000 manufacturers have been examined. An active campaign was conducted during the year, and is still under way, against those manufacturers who showed a dilatory, careless, or stubborn tendency to disregard the law. Nine criminal or seizure actions were instituted.

IMPORT MILK ACT

The Administration did not find it necessary to devote much attention to the enforcement of the Import Milk Act during the year. This was because of a large decrease in the number of importations of milk and cream. While the personnel engaged in this supervisory work was reduced to correspond to a material reduction in funds, there was maintained a skeleton force sufficient to give appropriate attention to such shipments of milk and cream as were offered for entry and also to inspect those farms and plants in Canada engaged in shipping operations.

TEA ACT

In the enforcement of the Tea Act, each shipment of tea offered for entry during the year was examined at one of the Administration's tea laboratories which are located in New York City, Boston, San Francisco, Seattle, and Honolulu. Consignments that failed to meet the official standards of quality, purity, and fitness for consumption were denied entry.

During the year the Administration examined 95,818,033 pounds of imported teas and found it necessary to reject only 38,159 pounds. The percentage of rejections, 0.04 percent, was extremely low. There has been a progressive improvement in the quality and purity of teas offered for importation into the United States during past years. Table 6 shows the quantities examined and rejected, together with the percentage of rejections for the past 10-year period.

TABLE 6.—*Teas examined and rejected, 1924–33* [1]

Year	Examined	Rejected		Year	Examined	Rejected	
	Pounds	*Pounds*	*Percent*		*Pounds*	*Pounds*	*Percent*
1924	104,492,743	63,159	0.06	1929	93,593,264	115,084	0.123
1925	92,925,470	84,137	.09	1930	84,732,677	207,884	.245
1926	98,551,814	457,537	.464	1931	87,091,330	49,253	.057
1927	97,595,579	100,708	.103	1932	90,587,055	90,321	.100
1928	91,105,613	57,121	.062	1933	95,818,033	38,159	.040

[1] The rejections are those made by the tea examiners, not the final rejections made by the U.S. Board of Tea Appeals.

NAVAL STORES ACT

During the past year, as in previous years, the naval stores trade, in general, continued to observe the requirements of the Federal Naval Stores Act in a satisfactory manner.

No shipments of adulterated turpentine were found. In a number of cases, minor and probably unintentional violations of the act occurred through faulty and incorrect labeling or invoicing of various kinds of wood turpentine. The violations in these instances usually involved the omission of the word "wood." In such cases, the necessary changes in the methods of labeling or selling the products in order to bring them into harmony with the requirements of the law were brought about through correspondence with producers or shippers.

A prosecution, based on a shipment of turpentine adulterated with kerosene, instituted during 1932, was brought to a close this year through a plea of nolo contendere by the defendant. The court fined the shipper $50.

Thirty-six factory inspections were made by Administration inspectors during the year. They covered producing, wholesale jobbing, and distributing plants and also the retail sale of spirits of turpentine of various kinds and grades.

Under the service features of the Naval Stores Act, Administration specialists classified and graded at turpentine stills in the South, for producers requesting such services, 101,294 barrels and drums of rosin. Seven hundred and thirty-eight additional barrels of rosin were graded on the request, either of producers or consignees, after the arrival of the naval stores at northern consuming points. These gradings were covered by 596 United States rosin classification and grading certificates. Analytical examination was made of 14 samples of turpentine submitted by interested parties. Laboratory gradings were made on two lots comprising 226 samples of rosin submitted. One lot represented a shipment which had been rejected after its arrival in Japan. The dispute which ensued was settled on the basis of the laboratory examination of the samples.

The sums collected by the Administration from those requesting these services amounted to $7,291. These funds were returned to the United States Treasury as miscellaneous receipts.

A large amount of work was done on rosin standards during the year. A set of proposed new modified standards was considered. Specialists of the Administration succeeded in devising a photo-electric spectrophotometer with which more accurate fundamental color analysis work has been done on the present rosin standards, on a set of rosin type samples corresponding to the glass standards, and on a set of proposed new modified standards which embody the changes suggested by the study of the present rosin standards. Field trial gradings have demonstrated that the grading of rosin will be simplified and made more accurate by use of the proposed new standards because of their better resemblance to rosin in color composition, and also because the color and grade, of both rosins of high brightness and of dirty rosins of low brightness, will be more accurately evaluated with the new standards than with the present ones.

COLLABORATION WITH OTHER BRANCHES OF THE SERVICE

The Administration continued its well-established practice of collaborating with other branches of the Government service, particularly with the Post Office Department and with the Federal Trade Commission.

The Administration answered 173 inquiries from the Federal Trade Commission relative to the therapeutic value of drugs, cosmetics, and devices that were under consideration in connection with the advertising of various manufacturers. Cooperative work with the Post Office Department resulted in medical briefs on 88 cases, and 246 analyses and tests of drugs, cosmetics, and devices. These articles were under consideration by the Post Office Department for the purpose of determining whether or not their distribution was in violation of the postal fraud law.

The food control unit examined approximately 1,600 samples of foods for various branches of the Federal Government. The distribution of these samples is as follows: Veterans' Administration, 65 percent; General Supply Committee, 18 percent; Department of Justice, 13 percent; and the remaining 4 percent from the Navy, Marine Corps, Department of the Interior, and soldiers' homes. Among other Government agencies with which the Administration cooperated in the examination of food samples were the Bureau of Foreign and Domestic Commerce, Bureau of Fisheries, Treasury Department, Public Health Service, Post Office Department, and the United States Coast Guard.

As in past years, the Administration continued to cooperate extensively with the Association of Official Agricultural Chemists.

The microanalytical laboratory examined 350 samples of foods, drugs, insecticides, and other products for various governmental organizations. Ninety-eight samples were analyzed for the Veterans' Administration, 18 for the Department of Justice, 68 for the Bureau of Chemistry and Soils, of the Department, 112 for the General Supply Committee, 26 for the Post Office Department, and lesser numbers for other Federal agencies, including the Bureau of Entomology, Bureau of Agricultural Economics, Department of the Interior, etc.

PUBLICATIONS

Publications printed during the year included, in addition to the annual report, 1,100 notices of judgment under the Food and Drugs Act, 35 under the Insecticide Act, and 9 under the Caustic Poison Act. Two service and regulatory announcements were issued. Eighty-five articles by members of the Administration were printed in outside publications.

U.S. GOVERNMENT PRINTING OFFICE: 1933

For sale by the Superintendent of Documents, Washington, D.C. - - - - - - - Price 5 cents

REPORT OF THE FORESTER, 1933

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D.C., September 1, 1933.

SIR: I transmit herewith the report of the Forest Service for the fiscal year ended June 30, 1933.

Respectfully,

ROBERT Y. STUART, *Forester.*

Hon. HENRY A. WALLACE,
Secretary of Agriculture.

THE PLACE OF FORESTRY IN PLANNED DEVELOPMENT

Natural resources support our whole economic structure; and land is by far the most important of them. Efficient land use concerns chiefly the use of the soil resources of the country to best advantage. Soil not only serves to grow the products of field, forest, and range but also stores water and controls its movement. Without this regulatory functioning of the soil, water would be a scourge instead of a resource; and without water land is a desert. The satisfactory adjustment of our national economy to the great dual resource of soil and water requires finding the right balance of agriculture, forestry, range use, and water-resource use with each other; and therefore the forest problem of the country is not isolated but is a part of a much greater one, now fast coming to the fore and becoming recognized as a problem of planned development.

That private interest and the public interest in efficient land use tend to coincide has been the generally accepted American theory. The national-forest policy, however, was a striking departure from that theory. Its inauguration led to a large-scale experiment in public control of land use as a means of obtaining a greater aggregate of public benefits than would flow from private ownership. The experiment was begun because the people of the West were deeply concerned for their vitally important water supplies. National-forest administration established control of the private use of the land for lumbering and grazing, and so safeguarded the water values as well as the value of the land for timber and forage production. The Forest Service soon had to find a principle to govern the use of land valuable for more than one purpose.

The principle decided on was that if a choice must be made between conflicting forms of use, the one which will make the land of greatest public utility must be provided for; but that if multiple-purpose use is feasible a plan for coordinated use must be worked out, so contrived as to yield the largest net total of public benefits. This planned and coordinated resource use has in view not only economic but also social welfare. The objective is stated in another fundamental principle that the national forests must be made to serve the greatest good of the greatest number, in the long run.

The national-forest experiment in public control of forest-land use has been on a large enough scale and long enough continued to furnish a thorough try-out. The results obtained have been highly satisfactory to the public. To abolish the national forests and allow private ownership of their resources would be out of the question. Public opinion would not permit it, because the national forests have demonstrated how much it is to the public advantage to have land uses rationally coordinated. And it is through demonstration of the workability of the principle of multiple use that the national-forest experiment has perhaps had its greatest value.

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While the scope of this experiment in public control of land use has been extensive, it has also been limited—partly fortuitously, partly on the basis of the character of the land and its resources. The national forests contain about 15 percent of the commercial-forest area of the continental United States, and about 30 percent of the forest land which will not grow timber of commercial quantity and quality. The latter includes lands of scrubby or very inaccessible forest growths and brush lands, important for watershed protection. In all, forest land makes up approximately 77 percent of the national-forest net area—that is, the area owned by the Government—in the continental United States. Most of the remaining 23 percent is in broken or scattered areas incidentally included because of their location. Some of it is bare rock, but in the main it has value both for grazing and for the control of water flows and erosion. The present extent of the national forests west of the Great Plains roughly represents the outcome of a gradual but still incomplete process of setting aside from private acquisition or the operation of State grants the unalienated forest lands of the public domain. The western national forest lands, however, also include a small percentage of lands that have been reacquired after alienation, through exchange. The eastern national forests are in the main the result of a gradual process of upbuilding through land purchases, as appropriations for the purpose permitted. Neither in the West nor in the East, therefore, do the national forests represent the outcome of a completed job consistently followed through, to substitute public control of forest-land use for laissez faire on any logical basis of distinction between lands desirable and lands undesirable for public administration. Instead, public ownership owes its present set-up largely to accident—in the West, to the accident of the particular lands which happened to be available for reservation; in the East, to the accident of the appropriation which happened to be thought expedient from year to year.

It has suddenly become widely believed that large-scale national planning must be undertaken quickly in the interest of a better ordered and better balanced economic and social development than laissez-faire individualism has been leading to. New public policies are being entered upon, and new experiments in public control and direction of the Nation's economic life are being set up. A far-reaching consideration of the possibilities of better resource use is taking place.

The practical urgencies of the immediate economic situation place in the forefront the problems of agriculture. Closely related with the problem of surplus agricultural land is that of idle cut-over land, much of which is plowable. Its cheapness and the anxiety of its owners to develop a market for it tend to induce an expansion of agriculture along lines similar to those which have already been largely responsible for the great number of submarginal farms. The depression has caused a back-flow of population from industrial centers to the rural regions, and this may readily lead to further clearing and settlement of land submarginal for agriculture. To bring the production of agricultural crops into balance with the demand for these crops calls for diminishing the acreage devoted to most of the major farm products. In the long run this must be brought about through a better balanced land use than unplanned development gives any promise of effecting without prolonged hardship and immense losses. Were nothing else involved, the problem of agricultural readjustment alone would necessitate a restudy of the problem of forest-land use and a more logical set-up for public forest ownership as a means of working out both problems.

But more than agricultural readjustment is involved. The Federal Government has entered upon another great experiment in planned resource development and use, more comprehensive than the national-forest experiment. The Tennessee Valley Authority has undertaken the upbuilding of the whole economic and social structure of a great region, through wise and farsighted planning for the best use of its soil, water, mineral, and human resources in a combined pattern that will aim at affording the most favorable conditions of life for all its people; in other words, at our national-forest aim of the greatest good for the greatest number in the long run. The forest resource must and undoubtedly will have a place in this planning commensurate with its regional importance. And that is very large. Permanent forests are essential for the region not only to supply wood for industrial and other uses, not only to make land productive which is not capable of affording the farmer a good living, but also to protect the watersheds, hold in check erosion, shelter and support wild life, add to recreational opportunities, make the whole countryside more habitable, heighten the beauty of the mountain landscapes, and enrich the common life. To bring about the necessary coordination of these multiple forest uses, extensive public acquisition and

administration of the forest lands of the basin will unquestionably be required as part of the general plan. Preparations for initiating this have already been begun by the Authority, which has set up within its organization an agency for the purpose.

THE COPELAND REPORT

A better basis for planning the measures necessary to efficient use of the forest resource in the interest of the common welfare than has ever before been available was provided by the restudy of the whole forest situation made by the Forest Service during the year, in compliance with the so-called "Copeland resolution" of the United States Senate. The resolution, adopted March 10, 1932, requested the Secretary of Agriculture to advise the Senate as to the desirability of Federal aid to the States "in the utilization for forestation purposes of those areas in the United States suitable for forestation only", with a full statement of the reasons for the course proposed and of the supporting facts. This struck deep into the whole question of public forest policy and the coordinated Federal and State action necessary to advance the general welfare most effectively. The answering report, A National Plan for American Forestry, was transmitted to the Senate March 27, 1933. It embodied the results of the most comprehensive and exhaustive survey of the entire field possible within the time and with the resources available. In transmitting it, the Secretary of Agriculture fully endorsed and recommended the earliest possible action on the Federal part of the plan. The situation disclosed by this study seems to leave no doubt of the necessity for recasting the public programs.

Hitherto private owners of forests have sought, with rare exceptions, not permanency of forest use but exploitation of the standing timber values. Out of nearly 400,000,000 acres of commercial timber-growing land in private ownership, of which 270,000,000 acres is in industrial holdings, less than 25,000,000 is under some degree of forest management. Overdevelopment of the lumber industry, largely due to too heavy investment in forest land for the sake of its present stand of timber, increases the instability of private ownership and the pressure to liquidate—to "cut out and get out." Cut-over lands which the owner has no further incentive to hold are a burden to be unloaded, either through agricultural development or through abandonment to public ownership. Few States are willing to assume the burden. Instead, the usual course is to try to pass abandoned lands back into private ownership so that they will again be a source of tax revenues. The overwhelmingly major trend in private forest-land ownership is toward progressive deterioration in the character of the forest, the value of the stand, the replacement through growth, and the productive capacity of the property. Less than 4 percent of the nearly 9,900,000 acres of private land cut over annually is cut over with regard for future yields, and more than 800,000 acres of private forest land is added annually to the already more than 83,000,000 acres so poorly stocked that it must be classed as devastated. Millions of acres of forest land have passed from private into forced public ownership through tax forfeiture, millions more are tax-delinquent and on the way to forfeiture, and other millions are steadily working nearer the time when their owners will no longer think them worth paying taxes on. Temporary forest ownership brought about in order to obtain and remove the standing timber is extensively breaking down.

This of course is not the whole picture. It is very far from being true that a universal breakdown of private forest ownership is in prospect and that if there is to be extensive forest perpetuation and forest management for timber growing it will all have to be as a public undertaking. Aside from the 125,000,000 acres of commercial farm woodlands, the great bulk of which can be classed as in a stable form of ownership, the Copeland report estimates that as much as 150,000,000 acres of private forests may still be in condition to afford promise of suitability for permanent private timber-growing enterprises. This amount may even be increased through private reforestation of some of the land on which there is now little or no restocking. Sound economic planning for the forest resource should give a large place to private ownership, and by every suitable means reversal of the drift toward abandonment should be attempted. It must nevertheless be recognized that a very large part of the forest land now privately owned has become so depleted of valuable timber and must wait so long before the forest capital necessary to afford a satisfactory income can be built up again, that only through public ownership can its restoration to a productive condition be looked for.

The "national plan for American forestry" proposed in the Copeland report calls for aggressive measures both to promote private forestry and to build up

public forests. With respect to the latter it recommends the immediate inauguration of Federal and State acquisition programs looking to the eventual public ownership of approximately 395,000,000 acres out of a total of 670,000,000 acres of commercial and noncommercial forest land, including some 55,000,000 acres of abandoned agricultural land. This requires a public-acquisition program for a total of 224,000,000 acres, much of which will be tax-reverting lands and which in the main would be of the same general type that makes up the bulk of the State and Federal acquisition now going on; that is, lands on which there is little valuable timber at the present time and which afford little prospect of future productiveness except through their public administration with multiple use in view. The State share in this program, it is believed, cannot reasonably be put at more than 90,000,000 acres. This leaves for the Federal share 134,000,000 acres. The Copeland report advocates a 20-year acquisition program to accomplish this, accompanied by an expansion of aid to the States in fire protection and other means of promoting both private and public forestry, and adequate Federal provision for the care and development of its own holdings and for the research basic to both private and public forestry practice.

The Copeland report dealt also with the possibility of stimulating the practice of forestry on privately owned lands through cooperative arrangements with the forest industries, under which their lands would be put under continuous forest production. The public would cooperate by permitting the industries to curtail output, by suitable arrangements for publicly sponsored loans adapted to the requirements of the forestry enterprise, and by other measures of assistance. Thus private owners and the public might work together on an equitable basis to obtain results in which both are vitally interested. It was recommended that an attempt be made to work out such arrangements at an early date.

When the National Industrial Recovery Act was in process of formulation the Forest Service recommended to the Secretary of Agriculture that its provisions be so shaped as to permit carrying out this plan. The act includes specific provision for the conservation of natural resources. After it was passed the President communicated to the representatives of the lumber industry, through the Secretary of Agriculture, a personal message informing them that "he trusts any code relating to the cutting of timber will contain some definite provision for the control of destructive exploitation."

A conservation article is included in the lumber code as approved by the President on August 19. Article I of the code states as one of its purposes "to conserve forest resources and bring about the sustained production thereof." Article X, the conservation article, further commits the lumber industry to the principle of the conservation and sustained production of forest resources. It provides that the applicant industries "shall forthwith request a conference with the Secretary of Agriculture and such State and other public and other agencies as he may designate." One purpose of the conference is to initiate the working out of the detailed provisions which shall govern the industries in carrying out the purposes of the code as to conservation and the commitments of the industry. Another purpose is to determine what cooperation of Federal, State, or other public agencies may be necessary.

Action has also been initiated by the Department looking to the adoption of practices of conservation for other classes of forest holdings. The codes now being formulated by the pulp and paper and the naval stores industries, for example, will presumably include provisions to this end.

THE ADVANCE BEGUN

The President's emergency conservation work, together with the public-works program and provision for accelerated land acquisition, has permitted a start toward meeting some of the objectives of the national plan for American forestry.

The emergency conservation work originated in the national need for unemployment relief and for counteracting its destructive effects on the manhood of those in their early working years. Of the 300,000 men enrolled in the Civilian Conservation Corps, by far the greater part were from the larger cities. Most of them had never seen the woods. Idle and undernourished as a result of conditions over which they had no control, at the outset they were incapable of normal sustained physical effort. Discouraged, their morale was low.

Visualizing these facts, the director of emergency conservation work formulated plans for execution by the Army to assure that the men enrolled should be given a preliminary period of physical conditioning and that they should have

special living and working conditions, medical care, and suitable food and recreation. The results in man-building have been phenomenal.

Woods work played its part in this development—work which is helping to put forest properties in condition to support other men year after year. The volume of woods accomplishment, in addition to what has been done in attaining the major objectives of relief and rehabilitation, is truly impressive. Most of it is work long planned by Federal and State forestry agencies for orderly accomplishment over the years.

For the Forest Service the first step toward getting the work under way was to select thousands of these previously planned projects, scattered throughout the most inaccessible portions of the United States, Alaska, and Puerto Rico, that would be suitable in character and location for being conducted from 200-man camps of inexperienced youths often actually working from 4 to 5 rather than 8 hours per day, and to select suitable camp locations. There was also the task of determining the kinds and quantities of tools, machines, trucks, and the like which should be provided for each project, and of procuring and distributing this equipment. Suitable supervisory men, with knowledge of the various jobs (many of which were highly specialized) as well as ability to lead, were recruited, instructed, and assigned. After the camps were established, the Forest Service took over each morning from the Army officers at the camps full charge of the enrolled men, to teach, encourage, and supervise them and then turn them back again to the Army in the afternoon. During the first 6 months there have been 597 camps located on the national forests. The Forest Service was also called upon to recommend for or against all projects on State and private lands (excepting State parks) in 47 States and to supervise and assist State authorities in the conduct of all work being done from the 660 camps established on these State and private lands.

After the close of the fiscal year $40,000,000 was allotted the Forest Service for road, trail, and improvement construction and maintenance as a part of the public-works program to provide employment and stimulate recovery. Here also the projects to be undertaken are projects called for under general development plans already made. Where camps are necessary they will be located directly on the various jobs, with each crew of the size that is best suited to the specific job on which it is working. Men are employed who are experienced, physically fit, and able to work 8 hours a day, for wages which offer a full incentive. There is, therefore, every reason to expect an output per man-day, week, or month which meets in every way the high standards previously set for similar work on the national forests.

An immense further impetus was given toward the achievement of the long-time objectives of the Federal forest policy when, on May 20, the President allotted by an Executive order $20,000,000 for resuming and accelerating the acquisition of lands in the East for national-forest purposes. This is further discussed in the section of this report on the National Forest Properties.

PROGRESS IN BUSINESS METHODS AND ORGANIZATION

The Forest Service continued its unremitting effort to improve its business practices and organization. Over a long period of years painstaking study has been directed toward finding out how effort can be better organized, objectives better selected and more clearly defined, business and technical methods improved, procedure simplified, responsibilities fixed, output increased, and costs cut down. In the field of executive management these studies have produced results recognized by outside experts in the subject as going beyond the best that private business has worked out. Through rigorous analyses of the time requirements of each job it has been possible to apportion the loads carried more evenly and thus reduce the working force necessary. Accounting methods have been bettered and financial control facilitated. More work and better work has been done by fewer people. The tightening-up process in the effort toward greater efficiency and economy has had cumulative results. The Forest Service welcomes comparison with any private enterprise in its organization and business system.

The cost-accounting system now operative in the Service, as briefly described in former reports, was adopted July 1, 1931. Installation has been accomplished on schedule. All units of the Service, comprising 188 national forests, nurseries, experiment stations, and regional offices, operated under the new system classification of expenditures during the fiscal year 1932 and completed the set-up of

investment and depreciation records during the year 1933. Results so far obtained have proved the system to be productive of reliable data and capable of meeting all demands for special or detailed cost information required for administrative decisions. During the latter part of the year, when the Forest Service was called upon to cooperate with other departments and bureaus in the colossal undertaking of placing 300,000 workers in forestry camps as a part of the President's emergency work program, the system proved capable of absorbing the increased volume of accounting detail without alteration.

The complete system becomes fully operative with the beginning of the fiscal year 1934. Built as it is upon advanced accounting theory and practice, it places the Forest Service in a rather unique status and more nearly in line with private industry in cost-finding practice. Its inauguration marks a decided forward step in cost control of governmental expenditures.

Despite the greater detail and completeness of cost information obtained under the new system, as compared with the system discarded at the close of the fiscal year 1931, its installation and development has been accomplished without addition to the clerical staff and with practically no additional costs.

DECENTRALIZATION OF ACCOUNTING, WAREHOUSING, AND PURCHASING FUNCTIONS

The nature of the Forest Service work is such as to require decentralization of the administrative organization in order to accomplish prompt action and permit direction of the work by officers thoroughly familiar with local and regional conditions, leaving to the central office the determination of broad policies and general direction of the work, with sufficient flexibility to prevent undue interference with accomplishment under varying conditions. In an organization of this type much of the related overhead functions can be most efficiently and economically handled if also decentralized. The centralization of portions of the accounting work has been attempted in the past, both in Washington and in the regional offices, and it was evident that instead of improving accuracy or reducing cost its effect was just the opposite. The centralization did not relieve the local organizations to any appreciable extent and resulted in no reduction of personnel, while it did add materially to the work of the central or regional organization. In the decentralized handling of accounting work it has been the aim to reduce duplication to the minimum, the detailed records being maintained in the local office only, while the records of the regional and Washington offices are confined to those necessary to permit effective fund control and to maintain all-Service records of the summarized data currently compiled by the field offices.

Similarly the decentralization of the warehousing function in large measure, dependent upon the local conditions as to labor supply, transportation facilities, et cetera, is necessary to effective action at reasonable cost. It is highly essential to have available locally or within working distance all tools, equipment, and supplies required for the suppression of forest fires. Often these can be most readily distributed from the place at which the crews are assembled. In some instances a centralized regional warehouse is effective; under other conditions it is not practicable. It has been the constant aim to devise for each forest or section the most economical and effective arrangement for the existing conditions. While promptness in organizing and equipping crews other than fire is not of the same urgency, usually the same distribution of warehouses is suitable for all field work in the locality.

The degree to which economy is served through centralization of purchasing varies widely. In some cases purchase from the General Supply Committee schedule is most economical. At times it has been possible to obtain, through independent competitive bids, much lower prices than those on the schedule for definite large quantities needed at one point or procured for shipment to one regional distributing point. Some local purchasing is unavoidable. It is invariably the practice in the Forest Service to utilize the most economical means of procurement, which calls for centralized or grouped purchasing in obtaining large quantities and in procurement of special equipment or supplies requiring special packing or processing to meet the requirements of the Service. Ordinarily the farther removed the procuring agency is from the consuming agency the greater is the overhead and intervening expense, which must be offset against the better prices obtainable on quantity purchases in determining which channel of procurement is in the end the most economical.

LEGISLATION OF THE YEAR

The acts making appropriations were:

The act of March 3, 1933 (47 Stat. 1432), making appropriations for the Department of Agriculture for the fiscal year 1934.

The act of June 16, 1933 (Public, No. 77, 73d Cong.), which is the Fourth Deficiency Appropriation Act for the fiscal year 1933. It appropriated $3,300,000,000 for expenditure under the Industrial Recovery Act of June 16, 1933 (Public, No. 67, 73d Cong.), and the Relief of Unemployment Act of March 31, 1933 (Public, No. 5, 73d Cong.). Not to exceed $50,000,000 of the amount appropriated was made available to the Directors of the Tennessee Valley Authority. This appropriation of $3,300,000,000 is to remain available until June 30, 1935.

The following acts relating to personnel and reorganization were passed:

The act of March 3, 1933 (47 Stat. 1489), which authorizes the President to reorganize the Executive Departments, and extends for the fiscal year 1934 the economy provisions of the Legislative Appropriation Act for the fiscal year 1933 (47 Stat. 399); see also Reorganization of Executive Departments, title 3, act of March 20, 1933 (Public No. 2, 73d Cong.).

The act of March 20, 1933 (Public, No. 2, 73d Cong.), which contains various provisions relating to the compensation of Federal officers and employees. This is the so-called "Economy Act."

The act of June 16, 1933 (Public, No. 78, 73d Cong.), the Independent Offices Appropriation Act, 1934, containing items relating to the retirement of civil employees having had a period of service of at least 30 years, and also authorizing furloughs.

The acts making or authorizing additions to national forests were:

The act of March 4, 1933 (47 Stat. 1569), which added approximately 123,830 acres to the Gunnison National Forest, Colo.

The act of March 4, 1933 (47 Stat. 1563), which authorized the addition of 640 acres to the Modoc National Forest by exchange.

The legislation relating to national forest administration comprised:

The act of January 19, 1933 (47 Stat. 771), which amends the United States mining laws applicable to lands within the Prescott National Forest, Ariz., from which the city of Prescott obtains its water supply, and prevents the acquisition of title to the surface of these lands under the mineral-land laws.

The act of June 13, 1933 (Public, No. 42, 73d Cong.), which authorized the President to create a game refuge within the Ouachita National Forest in Arkansas.

The act of March 31, 1933 (Public, No. 5, 73d Cong.), the Unemployment Relief Act, under authority of which conservation camps are established.

The act of May 18, 1933 (Public, No. 17, 73d Cong.), which authorized the development of Muscle Shoals and the Tennessee Valley.

The act of June 16, 1933 (Public, No. 67, 73d Cong.), the Industrial Recovery Act, which contains provisions relating to public construction.

The act of May 31, 1933 (Public, No. 28, 73d Cong.), authorizing the Secretary of Agriculture to segregate lands within the Carson National Forest for the benefit of Pueblo de Taos Indians of New Mexico.

PROGRESS IN STATE-FORESTRY LEGISLATION

North Dakota and Texas passed laws authorizing Federal land acquisition for national-forest purposes. Alabama altered the limitation under which Federal acquisition was restricted to lands within the Alabama national forest boundaries, to permit purchases in the Tennessee Valley; Missouri increased the maximum which might be acquired in any one county from 2,000 to 25,000 acres; Wisconsin increased the maximum for the entire State from 1,000,000 to 2,000,000 acres; and Tennessee no longer limits purchases to lands within 20 miles of the North Carolina State line.

Connecticut authorized the State forester to acquire land adjoining a State forest by exchanging for it the right to cut and remove from State forest land, within a period which may not exceed 10 years and subject to regulations prescribed by the State forester and under his supervision, forest products equal in value to that of the land. Florida authorized the board of forestry to recommend lands suitable for reforestation projects, State forests, and State parks, and to administer them when dedicated to this use by the trustees of the internal improvement fund.

Minnesota created 13 new State forests, and authorized acquisition of lands within them by gift, purchase, or condemnation. Purchase funds were made available out of the income from State forests and moneys of the Department of Conservation, of which a portion was allotted for the purchase of game refuges and public shooting grounds. Another law created a State forest fund and provided for payment of one half of the gross receipts from each forest to the county in which it is located. A newly created land-use committee in Minnesota is to classify all public and private lands in the State, principally with respect to their adaptability to present known uses such as agriculture and forestry, and report the results to the State legislature, with recommendations.

Montana authorized State land exchanges with counties, and New Hampshire authorized purchase by the State Forestry Commission, with the consent of the Governor and Council, of lands for State forests and reservations. Purchase money had previously to be supplied from private sources. Under supervision of

the commission, the State forester was given complete authority over the use of State forests and reservations, including reservations for public recreational and park purposes.

Ohio empowered municipal corporations to acquire by purchase, lease, or condemnation land for forest reserves. Oregon amended the so-called acquisition law, making it possible for county courts to transfer title to the State without an abstract. West Virginia created a public-land corporation, consisting of the governor and four other members, in which is vested the title to State lands acquired or which may be acquired through title forfeiture. The State corporation is to designate the use of the lands, and is to transfer or allot them to the appropriate State agencies, if their administration by the State is called for. Tennessee empowered the governor to set apart and reserve for State forests suitable State-owned lands, including lands which have become or may become tax-reverted, surface rights to lands held primarily for minerals, and any donated lands.

Colorado abolished the State board of forestry and the office of State forester and imposed all their powers and duties upon the State board of land commissioners.

Various States amended their fire laws. Nevada's 1931 law providing for Federal and State cooperation in forest fire prevention and suppression was strengthened by creating a special fund, to be used solely for protecting forest and watershed areas, subject to the approval of the surveyor-general. In Oregon the State forester now has authority to waive the slash-disposal requirement where burning the slash would create a further fire menace. A new Oregon law provides for a modified form of closure, corresponding closely to the Federal regulations dealing with entry into hazardous areas; the forester or a warden may now require entrants to have a permit for camping outside designated areas, to refrain from smoking, and to carry certain tools. This can be applied to areas where the hazard does not necessitate a complete closure. Rhode Island, Vermont, Washington, and West Virginia also added to their forest-fire legislation.

California provided that all State nursery stock must be sold for not less than the cost of production. Washington empowered the State forest board to use the forest-development fund to purchase land for growing timber. Previously this fund could be used only to pay interest and principal on bonds issued by the board for the purchase of cut-over lands. The board was also authorized, in order to carry on a reforestation program insuring a continuous timber supply, to block up areas located within counties where timber grows rapidly, and to purchase delinquent-tax lands from counties. Another Washington law set aside a block of State land on which the timber must be handled on a sustained-yield basis, the expenses of administration to be taken out of the gross proceeds.

Maine repealed the yield tax law, originally enacted in 1921 and completely revised and strengthened in 1929. Forest owners had made little use of the law until recently; but when changed economic conditions caused them to take advantage of its terms, the towns whose revenues were seriously affected insisted on its repeal. Minnesota extended the period of redemption of lands sold for taxes from 5 to 7 years, thereby preventing the law under which the State would have taken over title to several million acres of tax-delinquent lands in 1933 from taking effect for another 2 years.

An amendment to the New Mexico constitution authorizing the exchange of State lands in the national forests for Federal lands of equal value was submitted to the electors and carried at the general election in 1932. A Minnesota constitutional amendment authorizing the exchange of public lands of the State "for lands of the United States and other privately owned lands as the legislature may provide" will be submitted to the electors at the general election in 1934. An amendment similar except that it did not include "other privately owned lands" (mentioned in the annual report for 1931) was lost at the last general election, November 1932.

Laws specifically directing that forest work be made to afford employment to a maximum number of unemployed or partially employed citizens of the States were enacted by several States. Alabama authorized the State Forestry Commission to make rules and regulations covering the forests within the respective counties of the State in order to comply with the Reconstruction Finance Corporation's requirements in lending money for the preservation and reforestation of the forests of the county. Florida provided for the formation of limited dividend corporations which may secure funds from the same corporation for the protection and development of forests and other renewable natural resources. Minnesota, South Carolina, Tennessee, and Washington enacted legislation

permitting the borrowing of money for the promotion of reforestation and providing work for the unemployed. New Hampshire appropriated $100,000 for the fiscal year 1933–34, and a like amount for the following year, to be expended by the forestry department for improvement work on State and private lands as an unemployment-relief measure. The issuance of bonds to cover the amount appropriated was authorized.

WORK OF THE YEAR IN STATE COOPERATION

Federal appropriations for cooperative work with the States during the year, as compared with those in 1932 and 1934, are shown in table 1.

TABLE 1.—*Appropriations for State cooperation, 1932–34*

Item	Amount appropriated for fiscal year—		
	1932	1933	1934
For the prevention and suppression of forest fires, and for the forest-taxation inquiry and the insurance study (secs. 1–3 of the Clarke-McNary law)	$1,775,000	[1] $1,611,580	[2] $1,190,635
For the distribution of forest planting stock to farmers (sec. 4 of the same law)	95,000	79,960	[3] 56,053
For farm-forestry extension (sec. 5 of the law, administered by the office of cooperative extension work)	74,000	69,850	[4] 50,240

[1] The item of the appropriation act was $1,661,580. This was reduced by an administrative cut of $50,000.
[2] The item of the appropriation act was $1,587,513. It was administratively cut by $396,878.
[3] The item of the appropriaton act was $74,736. The administrative cut was $18,683.
[4] The item of the appropriation act was $64,787. The administrative cut was $14,547.

The results of the work are summarized in table 2, except those of the taxation study and the insurance inquiry, which appear on pages 36 and 37. Table 2 shows in detail the Federal, State, and private funds disbursed by the States or expended under their supervision for the prevention and suppression of forest fires, and the Federal and State funds disbursed by the States for the production and distribution of planting stock.

TABLE 2.—*Cooperative expenditures for fire protection and for the distribution of forest planting stock under the Clarke-McNary Act, fiscal year 1933*

State	For fire protection				For the distribution of forest planting stock		
	Federal	State	Private agencies	Total	Federal	State	Total
Alabama	$32,016.93	$11,736.85	$20,280.13	$64,033.91	$531.81	$531.80	$1,063.61
California	173,406.00	201,139.31	169,275.63	543,820.94	317.59	317.58	635.17
Colorado					1,493.01	1,493.01	2,986.02
Connecticut	13,603.00	55,261.61	1,592.54	70,457.15	2,000.00	2,287.04	4,287.04
Delaware	2,224.00	3,641.10		5,865.10	1,400.00	1,531.95	2,931.95
Florida	66,901.29	37,933.12	29,759.36	134,593.77	1,781.89	1,781.89	3,563.78
Georgia	39,057.65	17,862.90	21,194.76	78,115.31	2,000.00	2,408.65	4,408.65
Hawaii	444.00	2,036.64		2,480.64	2,750.00	8,687.24	11,437.24
Idaho	66,061.00	35,374.09	78,251.73	179,686.82	928.00	1,017.08	1,945.08
Indiana	6,894.00	7,744.14		14,638.14	2,350.00	17,687.26	20,037.26
Iowa					2,000.00	2,312.68	4,312.68
Kansas					1,480.25	1,480.25	2,960.50
Kentucky	4,737.77	4,737.77		9,475.54	1,406.00	2,357.68	3,763.68
Louisiana	47,046.00	32,811.97	26,244.55	106,102.52	1,751.15	1,751.15	3,502.30
Maine	58,360.00	135,087.13		193,447.13	669.28	669.25	1,338.53
Maryland	12,149.00	38,309.83	301.94	50,760.77	2,000.00	3,563.63	5,563.63
Massachusetts	32,508.00	69,924.13		102,432.13	2,252.00	5,332.81	7,584.81
Michigan	119,871.00	282,835.77		402,706.77	2,148.00	6,875.12	9,023.12
Mississippi	18,591.03	15,059.81	3,531.30	37,182.14	538.35	538.37	1,076.72
Minnesota	95,081.00	227,279.49		322,360.49			
Montana	26,052.00	13,817.88	36,071.32	75,941.20	2,000.00	2,178.05	4,178.05
Nebraska					2,367.00	11,395.00	13,762.00

TABLE 2.—*Cooperative expenditures for fire protection and for the distribution of forest planting stock under the Clarke-McNary Act, fiscal year 1933*—Continued

State	For fire protection				For the distribution of forest planting stock		
	Federal	State	Private agencies	Total	Federal	State	Total
Nevada	$1,885.00	$105.00	$4,114.71	$6,104.71			
New Hampshire	17,058.00	41,139.49	5,202.83	63,400.32	$2,255.00	$3,621.84	$5,876.84
New Jersey	24,977.00	117,460.40		142,437.40	2,605.00	14,889.52	17,494.52
New Mexico	2,171.40	2,762.00	2,620.00	7,553.40			
New York	63,481.00	242,740.68		306,221.68	2,945.00	17,591.50	20,536.50
North Carolina	36,564.37	31,811.36	4,753.02	73,128.75	2,000.00	2,582.59	4,582.59
North Dakota					2,241.00	7,334.15	9,575.15
Ohio	5,903.00	9,184.47		15,087.47	2,384.00	18,629.70	21,013.70
Oklahoma	13,903.08	12,983.24	919.90	27,806.22	2,000.00	3,328.38	5,328.38
Oregon	98,288.00	22,466.45	115,680.43	236,434.88	1,583.98	1,584.00	3,167.98
Pennsylvania	56,270.00	231,298.27		287,568.27	2,775.00	16,549.68	19,324.68
Puerto Rico					2,185.00	5,905.04	8,090.04
Rhode Island	1,733.00	7,687.83	3,936.41	13,357.24			
South Carolina	23,606.14	9,071.73	14,608.11	47,285.98	2,000.00	2,737.45	4,737.45
South Dakota	847.00	871.93		1,718.93			
Tennessee	19,600.01	19,937.30	2,715.52	42,252.83	2,105.00	3,973.81	6,078.81
Texas	39,924.00	36,600.99	10,638.00	87,162.99			
Utah					1,300.00	1,475.50	2,775.50
Vermont	6,112.00	9,360.87	3,925.52	19,398.39	2,000.00	5,027.68	7,027.68
Virginia	32,129.00	37,049.44	4,065.85	73,244.29	2,000.00	2,389.31	4,389.31
Washington	95,149.00	69,251.50	67,154.98	231,555.48	2,000.00	2,217.20	4,217.20
West Virginia	26,810.00	52,948.84	22,086.83	101,845.67	2,000.00	5,226.20	7,226.20
Wisconsin	70,693.00	345,194.76		415,887.76	2,000.00	2,651.36	4,651.36
Wyoming					1,522.00	2,079.06	3,601.06
Administration and inspection	76,032.19			76,032.19	3,031.97		3,031.97
Total	1,528,139.86	2,492,520.09	648,925.37	4,669,585.32	77,097.28	195,991.46	273,088.74
Forest-taxation and insurance study	47,641.21						
Impoundage	12,299.63				550.25		
Unexpended balance	23,499.30				2,312.47		
Total appropriation	1,611,580.00				79,960.00		

COOPERATIVE PROTECTION OF STATE AND PRIVATE FOREST LANDS FROM FIRE

In the calendar year 1932 approximately 223,000,000 acres of State and private forest or potential forest lands were reported by the States as under some form of organized protection from fire. The acreage protected is 53 percent of the total forest area classed as needing protection.

Table 2 shows a total of $3,141,445.46 State and private funds spent by the States and private owners in cooperative forest fire protection in the fiscal year 1933. The corresponding totals for the fiscal years 1932, 1931, and 1930 were $4,370,274, $5,011,421, and $4,117,652, respectively. The 1933 expenditures were slightly greater than those made in 1929 and 1928.

Thirty-eight States cooperated—the same number as in the previous year. Plans were formulated for adding Arkansas to the group, and the agreement for the project was signed by the State forestry commission on June 13, 1933.

The total area of protected State and private land reported as burned over by forest fires in the calendar year 1932 was 2,904,350 acres (of which 498,970 acres are classed as not having a productive value), as against 5,854,270 acres in 1931; and of unprotected forest lands 38,410,000 acres, as against 45,200,000 acres in 1931.

Within protected units the 2,405,380 acres classed as productive forest land which were reported as burned over constitute 1.1 percent of the forest area protected. It is significant that 93 percent of the State and private land burned over in 1932 was outside of protected units.

The number of fires reported for protected units of State and private land for the calendar year 1932 was 55,575, as against 56,443 in 1931.

COOPERATION WITH STATES IN TREE PLANTING

In the calendar year 1932, 23,500,000 trees were planted in windbreaks, shelterbelts, and farm wood lots by farmers, a decrease of approximately 8 percent from the 1931 record. As in the previous year, 38 States, Puerto Rico, and Hawaii engaged in the activity.

That none of these projects was discontinued, despite the sharp reductions in State budgets for all activities, is impressive evidence of the importance of forest planting on farm lands and of the appreciation of its importance by the States.

Federal assistance has been a large stabilizing factor. About 23,500 acres was added to forest plantations on farms by the cooperative effort. Pennsylvania distributed the largest number of trees to farmers, closely followed by New York, which is far in the lead in planting on State land. The States coming next to these two in farm planting are Ohio, Indiana, Nebraska, Michigan, Tennessee, Vermont, Wisconsin, New Jersey, Georgia, South Carolina, and Florida, in the order named.

COOPERATION WITH STATES IN FARM-FORESTRY EXTENSION

Thirty-three States and two Territories carried on cooperative extension work in farm forestry. This is an addition of one State, Montana, which began active cooperation on September 1, 1932. No State discontinued its project. A total of 8,223 farms were assisted in woodland improvement, 6,128 farm tracts were planted with seedling trees, 5,283 windbreaks were established (an increase of 607 over the previous year), 3,371 cleanings were made for controlling white pine blister rust, and 8,195 farms were assisted in various other projects, including marketing of timber products, estimating standing timber, maple-sirup production, and fire prevention.

Federal cooperation in farm forestry, authorized under the Clarke-McNary law (sec. 5), is conducted as a part of the extension program of the several State agricultural colleges and is administered by the Extension Service of the Department of Agriculture, with the cooperation of the Forest Service.

Outstanding progress with substantial increase was made in 4-H club activities. The enrollment of boys and girls conducting forestry projects totaled 15,732, an increase of 48 percent, and 11,416 projects were completed. This junior activity on farms is now being conducted in 39 States and 1 Territory, of which 8 States and the Territory were added during the year. The club work assumes largest importance in Michigan, New Hampshire, New Jersey, New York, North Carolina, Ohio, Tennessee, and Wisconsin.

NATIONAL-FOREST ADMINISTRATION

The expenditures for national-forest administration, protection, improvement, and extension, amounting to $26,415,714.41, are shown in detail on page 45.

The appropriations and allotments of Federal funds for the national-forest enterprise in the fiscal years 1932, 1933, and 1934 are shown in table 3.

TABLE 3.—*Appropriations of Federal funds and allotments from the National Recovery Administration for the national-forest enterprise, 1932–34*

Item	1932	1933	1934	
			Appropriation	Allowable expenditure
Appropriations:				
General expenses of administration, protection, and improvement	$7,809,880	$7,483,824	$6,896,699	$6,041,321
Specifically for:				
Fire control	4,410,000	1,125,000	124,900	112,450
Improvements, tree planting, land and resource surveys, and land adjustments	2,866,440	1,371,470	1,381,814	367,652
Land acquisition	2,000,000	200,000	85,854	
Roads and trails (construction and maintenance) needed primarily for forest protection and development	3,496,243.59	8,227,302.60	260,343.30	250,000
Highway construction and maintenance primarily to meet public needs, as a recognition of Federal responsibility created by ownership of untaxed lands	9,500,000	10,905,000	4,457,400	4,457,400
Allotments from National Recovery Administration:				
For land acquisition			[1] 20,000,000	[1] 20,000,000
For improvements, tree planting, land and resource surveys, land adjustments, tree-disease and insect control, etc			[1] 15,982,745	[1] 15,982,745
For roads and trails (construction and maintenance) needed primarily for forest protection and development			[1] 10,000,000	[1] 10,000,000
For highway construction and maintenance primarily to meet public needs, as a recognition of Federal responsibility created by ownership of untaxed lands			[1] 15,000,000	[1] 15,000,000

[1] Available until June 15, 1935.

The second item in the 1933 column of table 3 is greater by $1,000,000 than the corresponding sums reported for 1933 in last year's report. This increase took place through a deficiency appropriation of $1,000,000 to replenish funds drawn upon for fire-fighting expenditures in excess of the nominal amount appropriated in advance for this purpose. As has been explained in earlier reports, this is an established procedure, since the amount that will be required cannot be foreseen and varies greatly from year to year.

The differences in the other appropriation items were brought about by the program for the reduction of the cost of Government. The final column indicates the sums available after applying the restrictions upon full use of the appropriations ordered by the Bureau of the Budget.

THE NATIONAL-FOREST PROPERTIES

The gross area of the national forests on June 30, 1933, was 186,837,499 acres, of which 24,828,354 acres was in ownership other than that of the United States, making the net area 162,009,145 acres. During the year the gross area increased 622,243 acres, and the net area 648,454 acres. Area computations based on better surveys and land data reduced the gross area 113,330 acres; eliminations by Presidential proclamations or Executive orders 15,220 acres, and State selections under land-exchange agreements 10,521 acres. On the other hand, Presidential proclamations and Executive orders added 623,945 acres, acts of Congress 123,829 acres, and land exchanges 13,540 acres.

Table 4 shows the additions and eliminations.

TABLE 4.—*National-forest additions and eliminations, fiscal year 1933*

National forests	State	Additions	Eliminations
		Acres	*Acres*
Absaroka	Montana		[1] 6,360
Arapaho	Colorado	[2] 960	
Ashley	Utah-Wyoming	[1] 43,525	
Blackfeet	Montana	[2] 628	
Black Hills	Wyoming	[2] 1,785	
Do	South Dakota	[2] 640	
Cache	Utah	[1] 10,114	
Carson	New Mexico		[1] 15
Gunnison	Colorado	[3] 123,829	
Harney	South Dakota	[1] 998	[4] 1,195
Nicolet	Wisconsin	[1] 466,254	
Shasta	California	[2] 6,065	
Sierra	do		[1] 8,785
Snoqualmie	Washington		[4] 9,246
St. Joe	Idaho		[4] 80
Tongass	Alaska	[1] 5	[1] 60
Wasatch	Utah	[1] 103,049	
Wenatchee	Washington	[2] 3,462	
Total		761,314	25,741

[1] Made by Presidential proclamation or Executive order.
[2] Private lands acquired through exchange.
[3] Made under acts of Congress.
[4] Made through State selections of exchange lands.

The largest addition in area was made by a Presidential proclamation which created the Nicolet National Forest, in Wisconsin, embracing lands purchased or to be purchased under the Clarke-McNary law. By proclamation the President also added to the Ashley, Cache, Harney, and Wasatch Forests adjoining lands chiefly valuable for timber production or stream-flow control. By an act approved March 4, 1933, Congress enlarged the area of the Gunnison Forest in Colorado. The remaining additions comprised lands acquired by exchange under special laws permitting the acceptance of lands outside national-forest boundaries. The elimination from the Absaroka Forest was transferred to the Yellowstone National Park, and that from the Sierra to the Yosemite National Park. A minor elimination from the Tongass Forest was to permit of entry under the Trade and Manufacturing Act. Aside from a small adjustment on the Carson Forest the remaining eliminations were made to permit of State selections in lieu of lands relinquished within national forests.

To promote economy of administration, the Rainier National Forest, Wash., was partitioned between the Columbia, Snoqualmie, and Wenatchee Forests in the same State, and the Cascade and Santiam National Forests, Oreg., were combined and redesignated as the Willamette National Forest. The Kaibab National Forest, Ariz., was transferred from region 4 to region 3, which administers all other national forests in Arizona, to facilitate the conduct of cooperative work with State agencies.

The need for a substantial enlargement of the national forests was strongly brought out during the year, both by the study of the forest problem pursuant to Senate Resolution 175, Seventy-second Congress, which afforded the basis for the Copeland report, and in other ways. Economic trends are increasingly demanding a systematic planning of all land use. Many movements originating in widely separated geographic centers are coalescing into a national movement, which has found expression in the national land-use planning committee and the national advisory and legislative committee, created by the National Conference on Land Utilization at Chicago in November 1931. The conclusions reached by these committees emphasize the need for extending the national forests. In this connection, it is appropriate to call attention again to the fact that a considerable acreage of public-domain forest lands still remains unappropriated and unreserved.

In planning the work of the Civilian Conservation Corps created by the act of March 31, 1933, many opportunities for effective and constructive work upon public lands of this character came to light Had these lands been within national forests, prepared plans and resident administrative organizations would have permitted more immediate and effective work and guaranteed its permanent public values and benefits. The public interest calls for the permanent retention of these lands in public ownership. If allowed to pass to other ownerships, they will probably have to be reacquired by the Nation to protect its welfare and security. To reserve them at once would be the wisest course.

LAND ACQUISITION THROUGH EXCHANGE

It is now evident that in private ownership the highly productive and largely cut-over forest lands which fringe so many of the national forests as a rule are not and probably never will be protected, managed, and developed to the degree necessary to make them most serviceable permanently to the general welfare. It is equally evident that few of the States concerned are or will be prepared to so protect and manage them. Their damage and deterioration tends to offset the benefits realized through administration of the neighboring lands within the national forests. Extension of the forests to embrace these outside lands is logical.

Several bills to enlarge the present authority to acquire outside lands through exchange were before the last session of the Seventy-second Congress or are now before the Seventy-third Congress, but none of these has been enacted. There are now on the statute books, however, 56 laws authorizing acceptances of lands for national-forest purposes and grants in lieu thereof of national forest or other land, with or without stumpage, or of stumpage alone. These laws indicate consistent recognition by Congress of the desirability of thus consolidating both public and private forest properties.

The volume of exchange business was approximately the same as during the preceding year. Many land-exchange offers were received, but the great majority of the landowners desired national-forest stumpage which would be immediately salable and thus would allow prompt cash liquidation of their holdings. Too extensive use of stumpage for exchange purposes would seriously curtail cash timber-sale receipts and the shares payable to the counties.

Privately owned lands within the national forests aggregate almost 25,000,000 acres. They continue to create many acute problems. About 40 to 50 percent of these lands probably is adapted to permanent and constructive private use and management. The rest generally was acquired primarily for its merchantable timber values, and after the timber is removed little further attention is given to the land. The resulting hazards of fire, disease, and insect damage add greatly to the cost and difficulty of protecting the public properties, while the different and frequently conflicting policies applied by the private owners in cutting their merchantable stands militate against the most economic utilization of the intermingled or related public timber. Were 12 or 14 million acres of the interspersed private lands and perhaps 6 or 8 million acres outside but contiguous to the national forests added to them their value would be enhanced and the costs of their protection and management reduced. Consequently there are multiplying proposals that the policy of purchasing lands be extended to the national forests in the Western States. Before that is done, however, consideration properly

might be given to employing for the consolidation of the national forests unreserved public lands which the Government does not plan permanently to retain, by giving equal values of these lands for private lands within the forests.

During the year another exchange with the State of Michigan was approved and submitted to the Secretary of the Interior for action. Through it the State will convey to the United States approximately 15,000 acres of lands within national-forest boundaries, selecting an approximately equal area of unreserved public lands situated within or near State forests. An extensive exchange with the State of New Mexico also was inaugurated during the year, a constitutional amendment authorizing it having been adopted. In Minnesota a constitutional amendment authorizing land exchange with the United States failed to secure the necessary two-thirds vote, although it did receive a majority vote. Consequently it is still impracticable to consolidate the respective State and Federal holdings in Minnesota. Pending exchanges with the States of Colorado, Montana, and South Dakota continued to receive consideration, but have not been consummated.

During the calendar year 1932 reconveyances to the United States of 190,259 acres of private lands in exchange for 41,953 acres of national-forest land and 113,438,000 board feet of national-forest stumpage, valued at $397,964, added a net 148,306 acres to the forests. The Secretary of Agriculture approved and referred to the Secretary of the Interior for further action 105 new offers of 145,582 acres of privately owned land in exchange for 28,629 acres of national-forest land and $170,009 worth of stumpage. In all, to December 31, 1932, 923 land-exchange cases had been consummated. Through them the United States has acquired 1,395,359 acres of land, valued at $5,520,046, in exchange for 432,368 acres of national-forest land, valued at $1,998,507, and 976,522,000 board feet of national-forest stumpage, valued at $2,775,357. Besides the net gain of 962,991 acres in national-forest area the volume of stumpage on the acquired lands is much greater than that surrendered.

LAND ACQUISITION THROUGH PURCHASE

The approval with which land acquisition through purchase is now regarded is strikingly illustrated by recent developments in a number of the Eastern States. As has already been shown on page 7, during the year Texas enacted a law authorizing Federal purchases of forest lands; Alabama enlarged its act of consent to include all lands on the drainage of the Tennessee River; Tennessee made its act applicable to the entire State; Missouri, which previously had limited Federal land purchases to a maximum of 2,000 acres in any single county, increased that limit to 25,000 acres; and Wisconsin, where the limit on Federal purchases was first fixed at 250,000 acres, later at 500,000 acres, and still later at 1,000,000 acres, increased it to 2,000,000 acres. The establishment of two national-forest purchase units in the State of Illinois is earnestly advocated by its governor, by its State conservation agencies, and by many local groups; the establishment of several additional units in Mississippi is being aggressively proposed; there is a strong movement in favor of the creation of additional national forests in the eastern part of North Carolina; and keen interest recently has been manifested in the establishment of a new national forest in Maine.

The availability of national forests as fields for the constructive employment of the Civilian Conservation Corps doubtless did much to stimulate interest in the enlargement of the national-forest system. But recent trends in land economy and better analyses of factual data have inspired increased recognition of the tremendous and urgent requirements of the forest situation, the improbability of adequate private action, the inability of the States to carry the whole load, and the fact that the problem is national in its scope and consequences. The most liberal estimates of probable or practicable State and private action for the protection, maintenance, or restoration of forest resources leave an enormous acreage upon which the depletion or destruction of soil and forest resources, with all its attendant evils, will be averted only by Federal action, if it is to be averted.

The forest-land purchase provisions of the acts of March 1, 1911, and June 7, 1924, popularly known as the Weeks law and the Clarke-McNary law, are applicable to all parts of the United States but have been applied only to those parts east of the Great Plains. The States west of the Great Plains contain only 26 percent of the total commercial forest area, but 95 percent of the national forest area. The eastern half of the United States, with 74 percent of the total acreage of commercial forest, includes only 5 percent of the area of national forests. The need for an enlargement of the national forests is most urgent and acute in the eastern half of the country, and consequently all appropriations for purchases of forest lands have been expended therein.

The hitherto approved and governing objective of the purchase program has been ultimate Federal ownership of approximately 16,000,000 acres of forest lands east of the ninety-fifth meridian. Factual surveys and analyses now indicate that east of that line something more than 100,000,000 acres of forest land eventually should be protected and administered by the Federal Government. The eastern half of the country not only contains three fourths of the commercial-forest area but also almost 90 percent of the total population and the majority of the watersheds most important for navigation, water supply, and flood control. An early enlargement of the purchase program through the establishment of additional purchase areas and extensions of existing units is dictated by all available information.

The economic situation resulted in a strong tendency to liquidate ownership of forest lands, and many offers of sale were received at prices much below previous levels. Since the appropriation for the acquisition of land during the fiscal year was barely enough to complete the cases previously approved by the National Forest Reservation Commission, action on new offers appeared wholly impracticable. By Executive order of May 20, 1933, however, the President allotted for the purchase of lands $20,000,000 of the funds made available by the act of March 31, 1933, thereby permitting early action upon the large acreage which had been offered, examined and appraised, and covered by options at prices acceptable to the United States.

The stimulus of this action has been tremendous. It has made possible an acceleration and broadening of the acquisition program that has put a wholly new aspect on the whole situation. Before the action was taken, completion of the already established purchase units required the further purchase of more than 7,600,000 acres, and progress had been brought to a standstill for lack of funds. The incomplete condition of the purchase units was a serious obstacle to the most effective use of the Civilian Conservation Corps on the eastern national forests. But the whole outlook was changed literally overnight when the new fund was unexpectedly made available by the President.

During the next hundred days there was approved for purchase by the National Forest Reservation Commission the equivalent of about one fifth the entire acreage acquired during the preceding 22 years, and almost twice as much as during any preceding fiscal year. The total is 941,585 acres, to cost $1,763,964. Another notable development has been the approval by the Secretary of Agriculture and the National Forest Reservation Commission of an extensive series of new purchase units and additions to existing units, whereby the area to be purchased is increased by approximately 6,000,000 acres. Of the approved new units 4 are in Mississippi, 4 in Missouri, 2 in Illinois, 1 in West Virginia, 1 in Michigan, 1 in Minnesota, and 1 in Puerto Rico.

During the fiscal year ended June 30, 1933, title was taken under the Weeks law, as amended by the Clarke-McNary law, to 163,042 acres, at a cost of $678,709.57. Purchases totaling 672,425 acres and creating a total obligation of $1,229,200.04 were approved by the National Forest Reservation Commission. The average price was $1.85 per acre for the lands approved for purchase and $4.16 for the lands actually acquired, as compared with a previous average of $4.55 for all lands acquired. At the close of the year the average cost of all lands fully acquired, not including overhead, was $4.58, the total $20,578,410.51, and the area 4,532,698 acres, distributed by States as shown in table 5.

TABLE 5.—*Acreage of timberland purchases in the fiscal year 1933 and total purchases to July 1, 1933*

State	Purchased in 1933	Average price per acre 1933	Total purchased up to July 1933	State	Purchased in 1933	Average price per acre 1933	Total purchased up to July 1933
	Acres		*Acres*		*Acres*		*Acres*
Alabama	4,168	$5.43	116,333	Oklahoma	4,321	$1.64	58,900
Arkansas	15,045	3.12	324,655	Pennsylvania	1,879	6.51	371,155
Florida	5,102	3.44	234,364	South Carolina	129	6.53	47,602
Georgia	7,256	3.35	337,519	Tennessee	1,264	4.55	388,773
Louisiana	2,639	3.55	78,237	Vermont	29,539	10.74	31,381
Maine			33,482	Virginia	4,436	3.18	607,188
Michigan	5,932	1.82	309,183	West Virginia	2,831	3.70	330,115
Minnesota	2,675	1.61	130,580	Wisconsin	52,110	1.56	18,986
Mississippi	1,910	4.00	1,910				
New Hampshire	5,954	4.00	500,955	Total	163,042	4.16	4,532,698
North Carolina	15,852	3.94	412,280				

COORDINATION OF NATIONAL PARKS AND NATIONAL FORESTS

Under authority of earlier acts of Congress two areas were transferred from national forests to national parks by Presidential proclamation. The transfer of 6,360 acres from the Absaroka National Forest to the Yellowstone National Park was designed to include within the park certain winter range vital to the park antelope and elk herds. The transfer of 8,785 acres from the Sierra National Forest to the Yosemite National Park was to place within park boundaries all parts of the Wawona road. During the year agreement was reached to exclude from the Dixie National Forest, Utah, approximately 10 square miles embracing Cedar Breaks so that it might be established as a national monument under the administration of the National Park Service, but the formal Executive order to that end was not issued during the year.

The national forests contain many areas of exceptional scenic or recreational quality which annually are used by large numbers of persons. Frequently these same areas also contain important natural resources essential to the economic life and progress of dependent communities, or by their geographic situation control access to and utilization of large economic resources. In many instances carefully regulated industrial use of natural resources would be wholly compatible with full public enjoyment of esthetic, inspirational, and recreational qualities. Often the division of a particular territory between two separate administrative organizations imposes additional and burdensome requirements upon local citizens and markedly increases administrative costs. Accordingly, all determinations of proper national-park and national-forest boundaries should be governed by advanced and applicable principles of systematic land-use planning and by comparative evaluations of all social and economic factors and requirements.

NORTHERN PACIFIC LAND-GRANT ADJUDICATION

The suit to adjudicate the equities of the Northern Pacific Railway Co. under the Land Grant Act of July 2, 1864, the resolution of May 31, 1870, and other supplementary laws, as authorized by the act of June 25, 1929, received the attention of the Department of Justice throughout the year, the Forest Service furnishing such cooperation as was necessary in relation to land classifications and valuations and other relevant matters. Briefs, evidence, and arguments were presented to and considered by the master appointed by the Federal court of the eastern district of the State of Washington, before which the case is being tried.

LAND ACQUISITION THROUGH DONATIONS

Acceptance of donations of lands for national-forest purposes is authorized by section 7 of the act approved June 7, 1924 (43 Stat. 653), and by the act approved March 3, 1925 (43 Stat. 1133), and a few donations have been made and accepted; but prior to the fiscal year 1933 they were not of sufficient volume or importance to warrant specific mention in this report. Recent trends, however, give promise that the consolidation and extension of the national forests through voluntary donations of lands by the owners will hereafter be a matter of frequent occurrence and increasing importance. Donations during the year amounted to 26,117 acres in California and 113,120 acres in Idaho. Because of the work incident to the review and adjustment of titles only 80 acres, in California, had finally been accepted at the close of the year, but there is every indication that all of the donated land will be acceptable.

SPECIAL USES

Special-use permits in effect at the close of the calendar year 1932 totaled 37,306, as against 36,457 at the close of the preceding year. Of the permits in effect, 17,615 were without charge and 19,691 were subject to annual-rental charges. The receipts for the fiscal year 1933, $278,182.35, were less by $14,975 than for 1932, but the difference is in part covered by notes from permittees who, unable to pay their fees but wishing to avoid removal of their improvements, offered notes for which the improvements would be ample security. The bill to authorize a maximum area of 80 acres for term permits has been reintroduced in the Seventy-third Congress, and its enactment is most desirable. With such authority, higher standards of construction and development could be obtained, and public services, public revenues, and taxable values would all be correspondingly enhanced. The national forests contain many areas valuable for purposes of commerce and industry which appropriately may be so employed without

conflict with the basic purposes and uses of the national forests, and their full development and use would contribute markedly toward the welfare of the dependent communities.

CLAIMS AND SETTLEMENT

During the calendar year 1932 reports on applications for homestead patents totaled 69, of which 61 were favorable and 8 unfavorable; while reports on applications for mineral patents numbered 145, of which 105 were favorable and 40 unfavorable. Notwithstanding a pronounced trend from urban to rural life, bona fide and nonspeculative applications for the listing of forest lands did not greatly increase. While placer mining within the national forests was greatly stimulated by increased industrial unemployment, the resulting placer locations are not ordinarily covered by mineral application. Many applications for mineral patent are due to the fact that if land of large value for purposes of commerce, industry, or recreation contains even slight evidences of mineralization, the general mining laws afford an excellent opportunity to establish private ownership, regardless of the public values involved. This situation should be corrected by appropriate legislative action.

PROTECTION FROM FIRE

All fire seasons are different, and in this respect only was the 1932 season normal. It had most of the characteristics of a "bad" year, yet never became one. Although it was an extraordinarily long, dry, hot, and windy season it did not result in an exceptional number of fires. July and August are normally the peak months in the West, but in 1932 the seasonal peaks were in June and September. The number of fires was 92 percent of the average for the last 5 years, the area burned 83 percent, the fire-fighting expenditures 47 percent, the damage 29 percent. It was a season of contradictions, with near-emergencies, near record-breaking achievements, and only one really bad fire.

It opened early, both East and West—before the protective force had been increased to full seasonal strength. In the Northwest the June precipitation was below normal and dangerous conditions developed. July and August continued dry, with the precipitation below normal and wind velocities above. This condition held into September, and still longer in southern California. From the standpoint of duration of fire weather, shortage of precipitation, and wind, the record was one of the worst known. But what precipitation fell was well distributed; there were no bad concentrations of lightning fires; and there were no long periods of extremely low humidity such as those which characterized the 1931 season. The organization functioned with machinelike precision and had the situation under complete control down to September 7. Until then, less than half an acre had been burned over for each thousand acres protected. On that date a hunter on the Santa Barbara Forest in California started a fire which spread rapidly, burned 12 days, and required for its control a crew of 2,500 men. Except for this fire the record closely parallels that of 1930, a very much shorter and easier season.

Protecting the 160 million acres of national-forest land from fire is not only a large but also a very complex job. Years ago it was realized that there is no single road to success. The problem has to be worked out through the gradual development and coordination and perfection of all factors—equipment, transportation, communication, and personnel. In the nature of the case progress is slow, laborious, and difficult to gage accurately. Chance plays a large part; and the possibilities for a small slip-up somewhere are well-nigh limitless. A man may be well-trained in a hundred things, yet for lack of preparedness on one more let a fire get away; one out of a thousand telephones, all supposedly in perfect order, may be off for an hour just when it is most needed; favorable weather may cause overconfidence that will suddenly prove unfounded. Such things as these make caution necessary in comparing the records of successive years. Table 6 shows the 1932 fire record, in comparison with that of 1931 and with the 5-year average for 1928–32.

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TABLE 6.—*Comparison of fires on national forests, calendar years 1932, 1931, and 5-year average, 1928–32*

Class of fire and cause	Number of fires			Percentage of total		
	1932	1931	Average, 1928–32	1932	1931	Average, 1928–32
Class:						
Burns of 0.25 acre or less	4,146	4,676	4,291	58.92	55.23	56.07
Burns of between 0.25 and 10 acres	1,811	2,258	2,054	25.73	26.67	26.84
Burns of 10 acres and over	1,080	1,532	1,308	15.35	18.10	17.09
Total	7,037	8,466	7,653	100.00	100.00	100.00
Cause:						
Railroads	85	166	199	1.21	1.96	2.60
Lightning	2,690	2,917	3,267	38.23	34.45	42.69
Incendiarism	1,268	1,444	1,095	18.02	17.06	14.31
Debris burning	281	449	309	3.99	5.30	4.04
Lumbering	49	92	103	.70	1.09	1.34
Campfires	747	992	775	10.61	11.72	10.13
Smokers	1,564	1,872	1,526	22.22	22.11	19.94
Miscellaneous	353	534	379	5.02	6.31	4.95
Total	7,037	8,466	7,653	100.00	100.00	100.00

Calendar year	Total area of national-forest land burned over	Total damage of national-forest land burned over	Total cost of fighting fires, exclusive of time of forest officers
	Acres	*Dollars*	*Dollars*
1932	372,973	568,349	997,418
1931	532,761	3,652,248	4,049,466
5-year average, 1928–32	448,332	1,948,273	2,127,050

Most of the difference between 1931 and 1932 must be attributed to the weather. The improvement shown over the 5-year average, however, can hardly be so explained. It is best brought out by combining the factors of cost and damage. The objective in protection is to keep both low. By disregarding one, the other may be reduced. Last year the "cost-plus-damage" per fire averaged $223, as against $533 for the 5-year period.

Particular stress was laid on mastering fires during the first burning period. This requires quick and skillful action by a man power sufficient to insure control. Only 1 fire out of every 29 burned uncontrolled beyond the first period. In 1931 there was 1 out of every 24. In part this difference was due to the seasons, but in part to more effective action.

Both incendiary fires and smokers' fires outnumbered the 5-year average, but both were below the 1931 number. Incendiary fires fluctuate with economic conditions. In 1927 there were only 397; in 1931, 1,444. In 1932, control methods were effective wherever incendiarism was bad the year before, although unemployment conditions were even worse. Incendiarism broke out sporadically in a number of new localities, but in each case was quickly controlled. The total number of such fires was 12 percent less than in 1931.

Smoker fires also are affected by economic conditions. The number of men out of work revived prospecting and placer mining on a large scale. Many draws and stream courses were alive with prospectors and placer miners. Berry pickers also were unusually numerous. The men of both classes were careful and cooperative, but where there are great numbers of people there will be some fires.

The struggle of the Forest Service with fire has been going on for many years. A good job was being done 20 years ago. Progress becomes each year more difficult. Quick action has always been emphasized. Every minute of delay counts. Plans are made for quick action; men are trained for quick action; and equipment and improvements are designed with the same end in view. In 1921 and 1922, 39 percent of all fires were reached within 1 hour after discovery; in 1931 and 1932, 51 percent. This 12-percent gain brought 1,860 additional fires within the 1-hour period.

Another necessity is quick suppression. Tools have been designed to speed action, and emphasis has been placed on power equipment, particularly the horse and plow. In 1921 and 1922 45 percent of all fires were controlled within 1 hour after they were reached; in 1931 and 1932 55 percent. This was a gain of 1,550 fires. Since the later seasons were the more severe, no part of this gain can be attributed to natural causes.

One factor which still tends to keep records poor is the blind areas not directly covered by lookouts. To remedy this a study is being made in the fire regions of lookout points. Maps are being made from all points to show the area visible. From the combined maps the best series of points will be chosen to get the best coverage of the forest. The results indicate that some improvement can be made without increasing the actual number of lookouts.

This study of lookouts is not an isolated study but an exemplification of a broad and long-continued search everywhere for new fire facts. This search will be continued. It has resulted in a new type of portable radio practicable for field use, described in previous reports; it has developed a new type of protection road and the equipment for its construction; it has improved equipment and methods in a thousand different ways; and above all it has developed methods of organization which enable a ranger to expand his force a hundredfold, equip and supply the expanded unit, and begin effective work with no appreciable loss of time. But facts sought for are not confined to these mechanical features of the problem. We are concerned also with broader economic and social phases of protection.

In this connection probably the outstanding achievement in fire history for 1932 was the field study made of back-country or low-value areas. In 1930 the regional foresters agreed that the degree of protection should vary with the value of the timber, and made a rough classification based largely on types. Putting the idea into effect, however, developed two outstanding difficulties. The first is the difficulty of controlling the situation in this manner, less intensive effort sometimes resulting, in the end, in greater expenditures. The second is the difficulty in appraising values. The timber value, the only one subject to direct monetary appraisal, is not always the most important. Erosion control, water storage, recreation, and game values all have their place. Wilderness values have only recently been recognized, but in 50 years may be the greatest in some back-country localities.

During the 1932 field season two parties of forest officers made trips into one of the largest inaccessible back-country areas to discuss on the ground the values that were being protected and the possibility of using more extensive methods in their protection. The discussions resulted in a better understanding of the problem and in plans for further study. Experiments are being made in regions 1 and 6 to develop extensive yet safe methods in fire control. The principle is accepted that values protected should be greater than the cost of protection, but the control of costs when dealing with fire in the woods is difficult.

THE 1933 FIRE SEASON

The 1933 fire season up to September 1, the date of this report, has been considered an easy one, although exceptionally bad fires in both the Lake States and the Northwest, outside the national forests, indicate that there have been periods in which burning conditions were much above normal. However, such periods have been short as compared with those in the 1931 season, and while there has been considerable dry, hot weather, rains have been well distributed and humidity conditions usually favorable.

As to number of fires and area burned, the season so far has been almost a duplicate of last year. The number of fires up to August 20, 1932, was 4,353; up to the same date in 1933, 4,305. The area burned in 1932 was 75,649 acres, as against 64,823 acres this year. In cost-plus-damage, however, this year has so far a decided advantage. This may in part be due to the aid of the Civilian Conservation Corps.

The presence of this Corps has been in many ways a help. Their presence has emphasized the importance of the forests and the need for care with fire, and has been a deterrent to incendiarism; and the men themselves have done good work in fire fighting. On the other hand, the conservation camps have taken much of the time of administrative officers that normally is given to training and supervising the protection forces. The ultimate result, however, will be a multitude of young men interested from first-hand experiences in forest protection.

Unless there is some unlooked-for change in conditions the 1933 fire record will be one of the best in national-forest history.

PROTECTION FROM TREE DISEASES AND INSECTS

The white pine blister rust, the most menacing tree disease on the national forests, has continued its spread in the western white pine of Idaho, western Montana, and eastern Washington, despite control efforts which proved inadequate. If the disease is not checked the entire white-pine lumber industry of the inland empire will be practically wiped out. There are now 75 centers of infestation, of which 5 are new centers found in 1932 on the Clearwater National Forest and 5 are new centers found on the Coeur d'Alene. The disease attacks and kills the young growth and reproduction along with the mature timber, thus rapidly eliminating white pine from the forest. The disease has not yet reached the California sugar pine, the most valuable timber species of the State, but it has been found on sugar pine north of the California-Oregon line. Control is accomplished by finding and destroying all Ribes (currant and gooseberry) on the areas to be protected. Ribes and white pine are alternate hosts of the blister rust, and without both it cannot spread or survive. The Forest Service uses the methods of control recommended by the Bureau of Plant Industry, and works in close cooperation with that Bureau, which handles all the control work on lands outside of the national forests.

The best estimate is that there are at least 1,000,000 acres of western white-pine land owned by the Government within the national forests of the inland empire, of such excellent productive capacity as to justify large-scale control operations. The Forest Service undertakes control work only where the values at stake justify the outlay financially. If some other tree can be grown in place of the pine, that promises to afford a return equal to or greater than that obtainable from pine with the cost of control taken into account, control measures are not undertaken. The organization of the Civilian Conservation Corps has made possible a much more aggressive attack on the infestation since July 1.

From the standpoint of insect control, the year was signalized by two outstanding occurrences. Throughout the lodgepole, ponderosa, and western white pine regions other than the Southwest, there was the worst general insect infestation that has occurred in more than a decade. On the other hand, unusually cold weather in December 1932 and February 1933 probably resulted in the greatest mortality of the ponderosa pine bark beetles that has occurred in the last decade.

The major insect infestations are usually those of bark beetles. Beetle attacks gained momentum during the dry years of 1930 and 1931, and during the summer of 1932 the insects multiplied rapidly. Large-scale operations to control heavy lodgepole pine infestations were carried on in northern Utah and southeastern Idaho, on the Wasatch, Ashley, and Cache National Forests. The treatment consists mostly of spraying the infested tree stems with oil, which is then set fire to and more oil sprayed on until the bark becomes hot enough to kill the larvae. Only thin-barked species of trees can be successfully treated by this method. The entire Cache Forest, on which the largest job was undertaken, was cleaned of the epidemic. On the Wasatch and Ashley the control work was stopped by heavy snow in the fall of 1932, but was completed in the spring of 1933.

Control work was continued in the valuable western white-pine timber stands on the Coeur d'Alene National Forest, in north-central Idaho, where the work done in the spring of 1932 had curbed but not completely broken the infestation. A beetle attack which had been gathering headway during 1930 and 1931 in the ponderosa pine stands of eastern Oregon broke out furiously during the summer of 1932. Control work on a large scale was inaugurated on the Ochoco Forest in cooperation with the owners of adjoining private timber. The method employed was to fell the infested trees and burn the bark.

Abnormally low temperatures in December 1932, and again in February 1933, killed so large a percentage of the beetles on the Ochoco, Deschutes, and Fremont Forest that further measures of control were deemed unnecessary by the Bureau of Entomology, and the Forest Service was so advised. This saved unnecessary expenditures and exemplifies the value of the excellent cooperation given by the Bureau of Entomology, whose immediate investigation and interpretation of the results of the cold weather enabled the Forest Service to halt the work. Various degrees of mortality in the infestations of the same beetle took place in all three of the Pacific Coast States, as far south as central California.

In the spring of 1933 insect-control projects were undertaken on insect epidemics in the Sierra, Modoc, and Shasta National Forests of California. One of the Sierra projects and the Shasta project were carried on in cooperation with private owners of adjoining infested areas, and a project on the Wawona Basin area of the Sierra Forest, adjoining the Yosemite National Park, was handled

in cooperation with the Park Service. All insect-control work on the national forests is done by the methods recommended by the Bureau of Entomology.

TIMBER

The cut of national-forest timber under sales and exchanges was 473,910,000 board feet, as against 611,751,000 board feet in the fiscal year 1932 and 1,653,265,000 board feet in the fiscal year 1930. In view of the conditions in the lumber industry the production of lumber from national-forest timber was not encouraged. Extensions of time within which to complete contracts or to cut definite quantities were given on a liberal basis. Sales were closed only when, as in the case of two contracts for pulpwood in Alaska, it was evident that operations were unlikely to begin for an indefinite period. The policy was continued of not offering sales which would probably lead to the establishment of new large mills.

Toward the close of the year, with stocks of lumber in the yards and at the mills throughout the country greatly reduced, a revival of demand and production was reflected in a small but distinct increase in the national-forest timber business. The receipts from sales and the quantity of timber cut during the last quarter of the year were substantially greater than in the corresponding 1932 period. The upturn was widely distributed, the increase in receipts coming from all regions except California and Alaska.

In contrast with the continued low level of activity in large-scale timber operations, which in normal years account for more than 90 percent of the cut, the number of small sales (transactions involving $500 or less) has remained nearly constant through the depression. They are a highly important form of local service. In the calendar year 1932 they numbered 14,294, as against 68 larger sales. Free use increased sharply. More than 125,000 persons or organizations—an increase of 54 percent over 1931—cut a volume equivalent to 270,240,000 board feet, an increase of 61 percent. In many cases municipal or other organizations cut wood as a means both of furnishing labor to the unemployed and of obtaining a necessity of life for distribution to the destitute. This free use of timber was controlled and located so that the cutting removed fire dangers or improved conditions for the future growth of the forest.

The Civilian Conservation Corps started work on the national forests during the spring of 1933, and a large amount of stand-improvement work was planned for and begun. Stand-improvement work is needed on practically all national forests, but it is most needed on the eastern forests. This work consists mainly in liberation cutting, which is the removal of brush or of weed trees, usually of comparatively small size, to release trees of a more valuable species; thinning, which is the removal of a number of the trees on a given area in order to increase the rate of growth of the remaining trees and to shorten the period until the stand on the area will be ripe for a cutting; and improvement cutting, which is the removal of inferior species and insect-infested, diseased, or deformed trees, to benefit the composition and growth of the stand left. The work is done only in young stands.

All stand-improvement work for timber production on the national forests will be confined to work which is expected to yield a financial profit on the investment. Many thousands of acres of the national forests will be put in a much better condition for growth. There is and will be a large amount of work of this nature to be done annually, in the same manner as weeding of planted crops on a farm is an essential and worth-while investment. It is hoped that cultural or stand-improvement work may be continued annually on a scale adequate to keep the most valuable national forest timber-producing lands in the most profitable and productive condition. Stand-improvement work will yield large returns both to the local communities and to the Nation.

The national forest timber-sale business for the fiscal year is summarized in tables 7 and 8. Since the corresponding tables have for some years shown the record not by fiscal but by calendar years, this leaves a gap of 6 months between last year's record and that shown below. In the calendar year 1932 the cut under commercial sales was 366,076,000 board feet with a value of $815,105, as against 774,686,000 board feet with a value of $2,010,332 in 1931. The cuts under cost sales for the 2 years were respectively 17,639,000 board feet, with a value of $15,579, and 19,130,000 board feet, with a value of $17,657. The quantity of timber sold under commercial sales in the calendar year 1932 was 335,218,000 board feet, and under cost sales 17,361,000 board feet, as against 384,851,000 and 20,455,000 board feet in 1931.

TABLE 7.—*Quantity and value of national-forest timber cut under sales, fiscal year 1933*

State	Quantity cut			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	Board feet	*Board feet*	*Board feet*	*Dollars*	*Dollars*	*Dollars*
Alabama	2,000		2,000	11		11
Alaska	17,279,000		17,279,000	26,618		26,618
Arizona	74,723,000	249,000	74,972,000	178,059	244	178,303
Arkansas	2,011,000	629,000	2,640,000	9,022	629	9,651
California	57,941,000	1,383,000	59,324,000	127,102	932	128,034
Colorado	16,279,000	727,000	17,006,000	34,644	709	35,353
Florida	2,759,000		2,759,000	5,064		5,064
Idaho	19,095,000	5,582,000	24,677,000	52,877	4,478	57,355
Louisiana	134,000		134,000	62		62
Michigan	882,000	49,000	931,000	985	49	1,034
Minnesota	3,658,000		3,658,000	4,815		4,815
Montana	6,197,000	3,289,000	9,486,000	13,085	3,289	16,374
Nebraska						
Nevada	449,000	182,000	631,000	469	150	619
New Hampshire	1,848,000		1,848,000	6,609		6,609
New Mexico	7,624,000	864,000	8,488,000	15,392	874	16,266
North Carolina	8,339,000		8,339,000	19,397		19,397
Oklahoma	125,000		125,000	187		187
Oregon	24,827,000	2,675,000	27,502,000	52,583	1,793	54,376
Pennsylvania	597,000		597,000	1,128		1,128
Puerto Rico	12,000		12,000	305		305
South Dakota	12,905,000	226,000	13,131,000	43,812	220	44,032
Tennessee	1,515,000		1,515,000	3,772		3,772
Utah	4,131,000	1,165,000	5,296,000	7,932	1,177	9,109
Virginia	12,403,000		12,403,000	10,942		10,942
Vermont	6,000		6,000	12		12
Washington	84,540,000	200,000	84,740,000	181,412	141	181,553
West Virginia	24,000		24,000	109		109
Wisconsin	152,000		152,000	197		197
Wyoming	11,225,000	596,000	11,821,000	26,554	476	27,030
Total	371,682,000	17,816,000	389,498,000	823,156	15,161	[1]838,317

[1] In addition, minor products not convertible into board feet were cut, the value being $18,524.

TABLE 8.—*Quantity and value of national-forest timber sold, fiscal year 1933*

State	Quantity sold			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	Board feet	*Board feet*	*Board feet*	*Dollars*	*Dollars*	*Dollars*
Alabama	2,000		2,000	11		11
Alaska	23,372,000		23,372,000	35,356		35,356
Arizona	114,619,000	252,000	114,871,000	231,424	265	231,689
Arkansas	7,328,000	649,000	7,977,000	28,064	649	28,713
California	37,980,000	1,347,000	39,327,000	58,756	974	59,730
Colorado	10,664,000	749,000	11,413,000	21,786	688	22,474
Florida	1,850,000		1,850,000	3,440		3,440
Idaho	21,083,000	4,593,000	25,676,000	64,240	3,804	68,044
Louisiana	133,000		133,000	62		62
Michigan	1,062,000	103,000	1,165,000	1,445	103	1,548
Minnesota	1,373,000		1,373,000	1,851		1,851
Montana	8,378,000	3,578,000	11,956,000	19,743	3,522	23,265
Nebraska						
Nevada	518,000	228,000	746,000	366	186	552
New Hampshire	2,555,000		2,555,000	5,975		5,975
New Mexico	5,425,000	896,000	6,321,000	11,922	925	12,847
North Carolina	13,702,000		13,702,000	23,173		23,173
Oklahoma	125,000		125,000	186		186
Oregon	21,142,000	2,925,000	24,067,000	33,732	1,902	35,634
Pennsylvania	6,459,000		6,459,000	11,363		11,363
Puerto Rico	12,000		12,000	305		305
South Dakota	17,619,000	326,000	17,945,000	41,914	326	42,240
Tennessee	879,000		879,000	2,332		2,332
Utah	3,152,000	1,573,000	4,725,000	5,413	1,600	7,013
Virginia	12,882,000		12,882,000	8,950		8,950
Vermont	39,000		39,000	95		95
Washington	17,994,000	215,000	18,209,000	28,976	160	29,136
West Virginia	16,000		16,000	47		47
Wisconsin	211,000		211,000	231		231
Wyoming	7,795,000	635,000	8,430,000	16,957	588	17,545
Total	338,369,000	18,069,000	356,438,000	658,115	15,692	[1]673,807

[1] In addition, minor products not covertible into board feet were sold, the value being $31,711.

PLANTING

In the planting work the outstanding event of the year was the enactment of the Emergency Conservation Act. Despite the fact that only a relatively short period of the planting season was available after the first of the Civilian Conservation Corps camps were established in the woods, approximately 3 million trees were planted on national-forest lands by members of the corps before the year closed. All Forest Service nurseries were seeded to capacity, and a new temporary nursery was constructed and seeded at Cass Lake, Minn., which is expected to supply 15 million 1-year-old pine seedlings for planting in the fall of 1933 and approximately 50 million 2-year-old seedlings for the fall of 1934. Civilian Conservation workers are being largely used in maintaining the nurseries and preparing planting areas, and will be used in the fall planting.

For many years the planting program for the national forests has lagged. At the past rate, many hundred thousand acres of potentially highly productive timberland will long continue to be occupied only by worthless brush or weed trees. This constitutes a material economic loss. In the calendar year 1932 the area planted was 24,755 acres. Only once has a greater acreage been attained. But more than 2 million acres greatly need planting. An annual rate of 25,000 acres is totally inadequate. The act of June 9, 1930, commonly known as the Knutson-Vandenberg Act, authorized a planting appropriation of $300,000 for this year. The actual appropriation was $154,200. Since the act was passed the area to be planted has been increased through the purchase of additional eastern lands. The President has greatly accelerated the execution of the purchase program by making available $20,000,000 for this purpose. The lands to be acquired will in a considerable part be cut-over and burned-over areas, on which much planting must be done to make them fully productive. The work can be economically and effectively done only if a planned program can be followed through, with advance authorizations and corresponding later appropriations.

The area planted on national forests during the calendar year 1932 is shown, by States, in table 9. In addition 10 acres in Minnesota were sown.

TABLE 9.—*Planting on national forests, by States, calendar year 1932*

State	Area planted	State	Area planted	State	Area planted
	Acres		*Acres*		*Acres*
Arizona	11.4	New Hampshire	9.9	Utah	33.2
Arkansas	796.4	Nevada	5.0	Virginia	41.5
California	290.3	New Mexico	4.5	Washington	2,338.0
Colorado	2,548.4	Oklahoma	.5	West Virginia	319.1
Idaho	2,022.0	Oregon	139.0	Wisconsin	3,173.2
Montana	121.0	Pennsylvania	45.1	Wyoming	442.9
Michigan	9,386.5	Puerto Rico	.7		
Minnesota	96.0	South Dakota	1,519.4	Total	24,755.2
Nebraska	1,304.7	Tennessee	106.5		

RANGE

The winter of 1931–32, following widespread drought, in most of the range country was unusually severe. A general shortage of winter feed combined with inability of western producers to finance the purchase of high-priced feeds on a declining livestock market to cause heavy losses of livestock; and the early part of the year 1932 was most discouraging. As spring advanced, however, the situation in Montana, Oregon, Washington, California, Utah, Idaho, and Nevada became more promising. The heavy winter snowfall assured ample water for irrigation, while spring and summer rains brought on a crop of range and ranch forage in marked contrast to that of previous years.

Over much of Wyoming and Colorado, however, the heavy winter snow was followed by subnormal summer conditions; and parts of Arizona and New Mexico suffered a cold spring and spotty summer rainfall. Despite the adverse developments and the generally poor condition of the livestock at the opening of the season, stock left the national-forest ranges as marketable animals, in contrast to much unsalable stock from outside open range. Times of stress bring out pointedly the superiority of well-cared-for ranges over those subject to unregulated use.

GRAZING FEES

In 1932 livestock prices reached the lowest point in more than 20 years. This, coupled with the other unusual burdens of the stockmen, led to a demand for a reduction or remission of the grazing fee. After a thorough canvass of the situation, and in view of the previous winter losses, high costs of feed, and general drought conditions, the Secretary of Agriculture reduced the grazing fee by 50 percent for the season of 1932. To make the reduction of the greatest possible help, it was applied to the first installment of the grazing fees, which is due in advance of the opening date. Consequently the grazing receipts for the fiscal year 1932, which would ordinarily have been about $2,000,000, were reduced to $820,000.

While the unprecedented situation confronting the livestock grower during the past 2 years has brought about economies in operation, it has also brought increases in mortgage indebtedness and interest charges. In view of the emergency conditions the Forest Service made it known early in 1932 that no deserving stockman would be denied a grazing permit because of failure to pay a part or all of the fee in advance. Notes bearing interest were accepted where the permittee was unable to finance his operation through the regular channels, was fully qualified as a permittee, and had always met his obligations to the Forest Service. On December 31, 1932, unpaid grazing fees for the calendar year 1931 totaled $59,097.35, and for the calendar year 1932, $399,307.95, with 8,704 permittees, or 33 percent, delinquent. By the time the 1933 grazing season opened the amount due had been greatly reduced.

The general economic situation has given rise to a demand for a lower basic rate for the grazing fees. It will be recalled that the decision of the Secretary of Agriculture on January 25, 1927, which established the rates for the remainder of the 10-year term permit period ending with the 1934 season, expressly stated that for the next term-permit period consideration would be given the practicability of relating the grazing fees to the market prices of livestock. The users of the national forests argued with much force that no such severe depression as the present one had ever been experienced, and it was unlikely that its equal would ever be experienced again. It was urged that a readjustment would be especially timely, appropriate, and fair in view of the existing price situation, and all that was being requested was the advancement of the study by 2 years.

After full consideration of the question, the Secretary of Agriculture instructed the Forest Service to make the study. It led to the recommendation of a plan which was approved by the Secretary of Agriculture on May 27, 1933. Briefly, the new plan provides:

1. That the average national-forest grazing fees of 14.5 cents per head per month for cattle and 4.5 cents per head per month for sheep in effect during 1931 be used as the basic fees, subject to adjustment each year in accord with fluctuations in livestock prices.

2. That the adjusted fees each year shall have the same ratio to the basic fees that the average price received by producers in the 11 Western States during the immediately preceding year had to the corresponding average price during the period 1921–30, inclusive, in the case of cattle, and during the period 1920–32, inclusive, in the case of sheep.

3. That the cattle prices to be used in adjusting the fees shall be the prices received for beef cattle as compiled by the Bureau of Agricultural Economics, and the sheep prices shall be the prices received for lambs as likewise compiled by the Bureau of Agricultural Economics.

4. That in adjusting the grazing fees for 1933 in accordance with the provisions of the preceding paragraphs, 4.13 cents be considered the average price per pound for beef cattle for 1932, and 4.18 cents the corresponding price for lambs; that the average fee for 1933 as thus determined will be 9.05 cents per head per month for cattle, or 37.6 percent less than the average cattle fee determined by appraisal. For sheep the average fee in 1933 will be 2.05 cents per head per month, or 54 percent less than the average sheep fee determined by appraisal.

5. That the Forester be authorized to refund any amount collected for the year 1933 in excess of the adjusted fee, or to apply any such excess to the payment of any fees due or to be due, and to collect such additional payments as may be required to secure full payment of the fees as adjusted for the year 1933.

6. That no adjustments in fees be made when the application of the above formula would affect the fees by less than one-half cent for cattle and one-quarter cent for sheep per head per month, and that in the establishment of all fees they be rounded off to the nearest cent for cattle and the nearest quarter cent for sheep per head per month.

7. That the Forester be authorized to make such adjustments from time to time as may be necessary to establish equitable fees between allotments, forests, regions, or States.

In the reports submitting the plan, which was also approved by the Secretary, it is made clear that:

1. No usable means of determining directly the value of forage in terms of livestock market prices has been devised.

2. The best and most direct index of the value of forage on national forests is the price which stockmen pay for forage on comparable privately owned lands.

3. Forage values as thus indicated are adequately expressed in range-appraisal data used as the basis of grazing fees now in effect.

4. Rental values of private land tend to reflect price levels received for the commodities produced on the lands, but to a less marked extent and with a tendency to lag behind the changes in livestock prices.

5. By correlating the grazing fees as determined from the forage values on leased private lands with the average prices received for livestock over a representative period of years, a basis is provided for determining a working relationship between current grazing fees and current livestock prices.

The approval of this plan marks an innovation in the past policy. While it maintains the basic schedule of fees adopted in 1927, it recognizes that prices received by the producer year by year are the best indices to the ability to pay for a given commodity. So far as is known, it is the first attempt to employ such a method on a large scale. The success of the plan will depend largely upon its acceptance by the users with the understanding that fees will fluctuate with prices of livestock. This is exemplified by the working of the plan for 1933, when a low livestock price results in a reduction of the fee. As and when the prices of livestock increase, the grazing fee also will increase.

It should also be understood that this plan must be applied broadly. Fees will not be subject to adjustment to meet special conditions affecting individuals or localities only.

RANGE USE

Table 10 shows the grazing use made of the national forests in the calendar year 1932.

TABLE 10.—*Grazing permits issued and numbers of stock allowed under pay permit on the national forests, by States, calendar year 1932*

State	Cattle, horses, and swine				Sheep and goats		
	Permits issued	Stock grazed			Permits issued	Stock grazed	
		Cattle	Horses	Swine		Sheep	Goats
Alabama	1	20					
Arizona	985	187,841	1,421	157	108	290,072	1,786
Arkansas	184	3,383	15	135	2	38	
California	1,816	143,249	4,018	95	327	382,178	924
Colorado	3,067	281,444	2,470		903	992,133	537
Florida	23	1,354		22	2	719	
Idaho	2,640	120,732	5,214		952	1,289,137	
Montana	1,899	124,343	6,629		449	616,577	97
Nebraska	32	12,960	461				
Nevada	348	50,787	1,819		156	309,552	
New Hampshire	16	212	7				
New Mexico	1,996	88,669	2,148	104	304	211,156	9,064
North Carolina	115	761	1	8	7	104	
Oklahoma	46	2,312					
Oregon	1,128	83,695	1,521		470	643,083	30
Pennsylvania	2	52					
South Dakota	621	28,581	1,028		57	34,137	
Tennessee	47	345	1		4	63	
Utah	3,785	111,117	3,402	7	1,938	749,504	
Virginia	103	1,005	6		18	396	
Washington	436	13,038	396		120	149,393	
West Virginia	33	273	13		46	1,118	
Wyoming	752	104,987	4,535		294	639,140	
Total, 1932	20,075	1,361,160	35,105	528	6,157	6,308,500	12,438
Total, 1931	19,388	1,338,373	37,335	431	6,319	6,593,583	14,645

The table shows that 687 more permittees grazed 20,654 more cattle, horses, and swine in 1932 than in 1931; but the average of 70 head per permittee was 1 less than the 1931 average. On the other hand, there were 162 fewer sheep and goat permittees and 287,290 fewer sheep and goats than in 1931. These

differences are chiefly in response to the general economic situation. In 1932 7,013 cattle, 264 horses, and 83,246 sheep grazed, under interforest permit, on more than one forest in the course of the season.

In addition to the stock under permits, 62,055 cattle and horses and 8,359 sheep and goats were grazed in the six Western national-forest regions under the regulation authorizing free grazing of not to exceed 10 head of stock used for domestic purposes, and stock used by prospectors, campers, and travelers, or used in connection with permitted operations on a national forest.

Unfavorable seasonal and economic conditions combined to make both the authorized use and the actual use less in 1932 than in 1931. The authorized use was less by 13,537 cattle-months and 1,156,070 sheep-months, and the actual use by 75,821 cattle-months and 1,681,749 sheep-months.

The amount of nonuse, or retention of preference without grazing the stock, generally reflects economic conditions. Permittees were granted nonuse during 1932 for 79,900 cattle and horses and 410,902 sheep and goats. This is about the same number of cattle and horses and nearly twice the number of sheep and goats covered by nonuse during 1931.

STABILITY OF RANGE USE

The demand for summer range continues to be far greater than the national forests can supply. Many complaints were received from disappointed applicants for the grazing privilege. That the demand will increase as ranges improve on the national forests and decline on outside areas is, of course, to be expected. It is also to be expected that fully qualified applicants, or those who own and live on ranch property of a similar character to that owned by present permittees, will be dissatisfied under a combination of policy and conditions which excludes them while according others, who came before them, fairly permanent occupancy privileges.

While the Forest Service fully appreciates the situation of these applicants and seeks to make places for them wherever this can be done under the established policies, it holds that a distribution of the privilege which will accord as nearly as possible with the economic requirements of the business of livestock production will in the long run best serve community welfare. The effects of protracted and unusual drought have been manifested in reduced production of forage and overgrazing on certain areas, making it impossible to use much of the leeway ordinarily gained in connection with transfers of stock ownership and in other ways as a means of admitting new owners or allowing increases to small owners. Unless the operations of present users are to be greatly curtailed, with an attendant decline in the productivity of ranches dependent upon forest use, extending the distribution of grazing privileges will depend either upon building up increased carrying power through skillful range management or upon making room for new applicants in one way or another under the established procedure of the present regulations.

In some localities changes in economic conditions may have occurred during the past few years which will call for some adjustments at the close of the present term-permit period. This situation is being studied in order to meet the needs, so far as they can be foreseen, for the next period.

With the exception of certain areas where the extent of reductions in numbers of stock is uncertain, it is expected that the number under term permits for the next 10-year period will be approximately the same as is shown in table 11:

TABLE 11.—*Livestock allowed under term or 10-year permits on the western national forests, calendar year 1932*

Region	Number of stock under term permits		Percent of total	
	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats
1	58,445	262,584	40	36
2	168,572	667,278	41	47
3	149,601	298,129	51	61
4	270,746	2,262,152	78	90
5	48,169	125,897	32	32
6	24,019	352,578	23	43
Total	719,552	3,968,618	50	63

Important as may be, from the individual's standpoint, the mechanics by which stability in range use is secured, stabilized forage production is of far greater importance. That, of course, requires that every area not now supporting its maximum stand of usable vegetation be brought to full productivity. Then the all-absorbing question becomes how utilization can most advantageously be adjusted to the requirements of the vegetation and related resources. The nature of the problem calls for careful surveys and the development of long-time land-use plans. These plans contemplate full and complete use of the various resources, with impairment to none. In this field the Forest Service has made great progress. Its completed range-management plans are on a scale unknown elsewhere in the civilized world. The ultimate verdict upon those plans will be pronounced by future generations, but already there is clear evidence that planning, the use of scientific data, and application of the resulting knowledge by trained men warrant the prediction of complete success. The accomplishments year by year are in some cases difficult to determine, but the gradual progress of the years builds a record that might well be emulated by the owners of other lands of a similar character.

But stability of range use on the national forests cannot hope to remedy all the economic ills of the western livestock industry. It is a small, though important, part of what should be fitted into a broad program of better planning for the industry. In this the Government has a responsibility for its own land which should be met through quick and appropriate action for public domain range restoration.

In addition to the mechanics heretofore discussed and the means of securing continuity of forage production, there are still two main points of attack in increasing productivity. First, there must be ample equipment in the form of fences for the control of livestock; water development, so that even utilization of forage can be secured; and many other improvements essential to the application of the plans worked out for the more than 9,000 allotments on the national forests. This work has been proceeding for many years in cooperation with the stockmen, but much still remains to be done. Fast progress is now assured through the activities of the Civilian Conservation Corps and the allotment of funds under the public works program.

Table 12 shows the projects constructed during the fiscal year 1932.

TABLE 12.—*Range improvements constructed on national forests, fiscal year 1932*

Region	Fences		Corrals		Driveways		Bridges		Water developments		Miscellaneous	Total cost
	Miles	Cost	Number	Cost	Miles	Cost	Number	Cost	Number	Cost	Cost	
1	67	$15,774	------	$49	21	$2,287	------	------	206	$13,779	$516	$32,405
2	47	14,337	2	446	2	237	1	$200	40	3,853	8,608	27,681
3	180	46,146	------	4	------	------	------	------	4	1,409	2,180	49,739
4	34	11,036	7	520	------	127	1	167	118	22,794	4,375	39,019
5	21	4,832	4	545	3	349	------	------	75	13,316	2,727	21,769
6	39	7,228	5	596	11	190	1	20	124	8,142	5,960	22,136
Total	388	99,353	18	2,160	37	3,190	3	387	567	63,293	24,366	192,749

The second point of attack in increasing range productivity is to reduce to a minimum the annual losses of livestock from all causes. As indicated in table 13, these constitute a drain on the livestock industry, which should be eliminated by the application of known methods. Not only will reduction of losses increase benefits to stockmen, but in many instances successful use of ranges is largely dependent upon successful control of poisonous plants.

TABLE 13.—*Livestock losses, 1932*

CATTLE AND HORSES

Region	Poisonous plants		Predatory animals		Disease		Other		Total	
	Number	Value	Number	Value	Number	Value	Number	Value	Number	Value
1	316	$12,640	8	$320	134	$5,360	716	$28,640	1,174	$46,960
2	2,856	114,240	59	2,360	1,337	53,480	1,592	63,680	5,844	233,760
3	613	24,520	859	34,360	651	26,040	3,439	137,560	5,562	222,480
4	1,581	63,240	118	4,720	233	9,320	1,651	66,040	3,583	143,320
5	533	21,320	57	2,280	344	13,760	1,267	50,680	2,201	88,040
6	213	8,520	22	880	112	4,480	528	21,120	875	35,000
Total	6,112	244,480	1,123	44,920	2,811	112,440	9,193	367,720	19,239	769,560

SHEEP AND GOATS

1	3,106	$15,530	6,898	$34,490	1,290	$6,450	10,699	$53,495	21,993	109,965
2	8,752	43,760	12,124	60,620	3,280	16,400	10,218	51,090	34,374	171,870
3	1,190	5,950	3,334	16,670	708	3,540	2,971	14,855	8,203	41,015
4	9,920	49,600	30,294	151,470	5,402	27,010	17,203	86,015	62,819	314,095
5	2,235	11,175	3,615	18,075	878	4,390	4,162	20,810	10,890	54,450
6	3,093	15,465	6,309	31,545	3,105	15,525	9,201	46,005	21,708	108,540
Total	28,296	141,480	62,574	312,870	14,663	73,315	54,454	272,270	159,987	799,935

RECREATION AND GAME

Each year adds increased emphasis to the fact that public use of the national forests for a wide variety of forms of outdoor recreation is a major use and service, for which adequate provision should be made in all plans of administration and management. The social values and beneficial consequences of such use are incalculable. The estimated number of national-forest visitors in the calendar year 1932 shows, as did those for the two preceding years, that in times of economic depression and unemployment, as well as in times of prosperity, large numbers of people find in the national forests the popular, democratic, inexpensive, and relatively unrestricted types of outdoor recreation they most desire. Nor are the benefits wholly local; parked upon the camp grounds of a single forest may be found automobiles from almost every State in the Union and from some of its insular possessions. The economic existence of hundreds of communities along the routes leading to the national forests, or within their borders, depends in large measure upon the continuance and expansion of such recreational use, which also creates markets for the processed or manufactured products of all parts of the Nation. Full development of the scenic, inspirational, and recreational qualities of the national forests is dictated by all considerations of social service and economic well-being.

Estimates, more carefully made than ever before and with every effort to get rid of duplications, indicated that the visitors to the national forests during the calendar year approximated 35,718,434; a gain of 3,489,821 persons, which, however, was less than the increase in number of motorists, there being a small decline in the numbers of other classes. Specifically, there were 530,182 special-use permittees and guests; 1,138,634 hotel and resort guests; 2,178,231 campers; 4,011,646 picnickers; 6,407,128 motorists, horsemen, hikers, etc., who toured the forests primarily to enjoy their scenery; 37,150 unclassified; and 21,415,463 motorists, etc., who merely passed through the forests en route to their destinations but who nevertheless enjoyed in some degree the scenic charm of the forests and the facilities made available for recreationists.

Many of the forests are highly inflammable during the summer season, and many of the watersheds within the forests are used by municipalities as sources of water supply. The best protection to public property and public health against the hazards attendant upon the presence of such large numbers of persons is secured by the provision of camping and sanitary facilities which encourage voluntary concentration in areas of minimum risk. To that end, 1,984 national-forest public camp grounds have been established and at least partially equipped with simple facilities for sanitation and fire control. Expenditures for that pur-

pose during the year totaled $57,303, of which $3,460 was contributed by cooperators. The total cumulative cost of this work has been $487,840, of which $65,087 has been contributed by other agencies, in money, materials, or services.

Table 14 shows that for a majority of the species of big-game animals the number increased.

TABLE 14.—*Number of big-game animals on national forests, by States, estimated as of December 31, 1932*

State	Antelope	Bear		Deer	Elk	Moose	Mountain goats	Mountain sheep
		Black or brown	Grizzly					
Alabama				750				
Alaska		6,200	[1] 4,500	50,600	25	390	10,000	1,525
Arizona	5,810	596	5	87,700	5,680			280
Arkansas		6		1,925				
California	1,610	9,961		278,660	150			424
Colorado	112	2,860	3	47,780	13,610			3,341
Florida		255		2,500				
Idaho	2,734	4,903	50	57,365	9,282	421	2,886	1,654
Louisiana				10				
Michigan		185		5,850	4	1		
Minnesota		1,580		9,845	22	2,770		
Mississippi				6				
Montana	876	5,859	421	50,610	16,115	1,820	4,220	1,883
Nebraska				155				
Nevada	195	2		9,155	40			146
New Hampshire		780		4,050		10		
New Mexico	1,013	915	7	100,400	974			114
North Carolina		310		5,965	17			
Oklahoma		4		400	365			
Oregon	255	6,143	1	88,350	10,450			60
Pennsylvania		125		7,000	3			
South Dakota				4,765	315		12	
Tennessee		40		440				
Utah		516	4	67,420	2,940			157
Vermont		20		100				
Virginia		495		180	40			
Washington		8,641	7	35,990	9,379	1	4,618	6
West Virginia		300		125				
Wisconsin		74		7,900				
Wyoming	545	1,561	166	20,550	34,445	2,441		2,915
Total, 1932	13,150	52,331	5,164	946,546	103,856	7,854	21,736	12,505
Total, 1931	12,725	50,596	3,747	969,330	96,905	7,835	22,262	12,555

[1] Includes Alaska brown bear.

Mountain sheep and mountain goats, however, just about held their own. This is no doubt due to many factors, none of which is clearly understood although disease, predators, and winter feed may be assumed to be the controlling ones. The situation with these animals clearly presents the need of more thorough research, in which the various Federal bureaus and State agencies concerned should take the lead.

With all game species, excepting mountain sheep and goats, the problems are being more clearly visualized and advances made toward their solution. Protection from illegal killing, predators, starvation, etc., while important, is now being fitted into its proper place in broad plans dealing with range and animal productivity. The diversity of interests sometimes makes the development of plans most difficult, but by the constant development of facts and cooperation with the various agencies headway is being made in land-use programs. Control of factors detrimental to wild life, involving the adjustment of other uses, forces the exercise of expert knowledge and the use of such scientific data as are now available. Nowhere do we find, however, greater need for the fully qualified land manager than on areas where game, recreation, timber, grazing, and perhaps other uses are involved.

Planning the proper use of land is one thing; getting those plans into effect is entirely another question. As it pertains to wild life, the latter is much more difficult. Timber cutting, grazing of forage, or the use and occupancy of land for other purposes are all under the direct control of the Forest Service. Not so with game; the Forest Service may proceed with the development of plans, but unless the State game laws governing bag limits, seasons, etc., on game

conform to the requirements of a plan developed from biological and other facts, no constructive advance can be maintained. The Forest Service views with considerable satisfaction recent evidences of a better appreciation of the problems and a better and larger program of cooperation.

WATER POWER

The economic depression has markedly affected the use of electric energy from plants now operating and the estimates of future growth in market requirements. There was a big falling off during the year in the number of proposed developments. This reduced the demands on the time of Forest Service personnel for making investigations and reports on applications to the Federal Power Commission for permits or licenses. On the other hand, applications for amendments to existing permits or licenses have been more numerous and time-consuming than usual.

At the end of the year the Forest Service, at the request of the Federal Power Commission, was supervising the operations of 371 permittees or licensees under the Federal water power act, an increase of 17 during the year. The Commission requested the Forest Service to make investigations and reports in 46 cases, and 48 reports were made. The Forest Service also made two valuations or appraisals. The Power Commission during the year received 38 applications for permits or license. Of these 28, or 74 percent, involved the use of national-forest land.

As in previous years, fewer permits issued by the Department of Agriculture were in effect at the end of the fiscal year than at the beginning. The net reduction was 12. On June 30, 1933, 210 of these permits were in effect. They consisted of 99 permits or easements for water-power projects, with an average low-flow output estimated at 515,966 horsepower, and 111 permits or easements for transmission lines only, with a total length of 905.56 miles within the national-forest boundaries. Of the power projects, 52, with an estimated output of 490,815 horsepower, and of the transmission line cases, 88, with a length of 738.13 miles within the forest boundaries, require the payment of an annual rental. The estimated average output of the power projects covered by free permits was 535 horsepower. The transmission lines under permits providing for no annual rental cover a length of 167.43 miles within the forests.

The administrative instructions for handling the waterpower work were thoroughly reviewed and very largely revised. Much time was devoted to checking up on the compliance of Department of Agriculture permittees with the permit provisions. Conflicts between water power and other uses of forest land, particularly for highways, continued on a large scale. Much time and thought were given to th s matter, especially in cooperation with the Power Commission, but a determination of general policy and principles has not yet been made.

The slowing down in the demand for power permits and licenses made available some time of engineers which it was planned to utilize in making a thorough field study of forest lands under power classification or withdrawal and in inventorying the waterpower resources of the forests and determining what lands have greatest value for power uses. The time requirements of the emergency conservation work, however, prevented even a start on this work.

ROADS AND TRAILS

Table 15 shows the present status of the transportation system planned for the national forests. Roads required for public travel, as well as for the protection, administration, development, and utilization of the forests, are included. The roads required primarily for public travel are the forest highways. Tables 16, 17, and 18 show by States the mileage constructed and maintained, the expenditures, and the apportionments of the various road funds; and table 19 shows the condition of these funds at the close of the year.

TABLE 15.—*Classification of mileage in forest road and trail system and expenditure required to complete the system to a satisfactory standard*

Class	Miles				Expenditure required to complete
	Total	Satisfactory standard	Unsatisfactory standard	Nonexisting	
Forest highways	16,852	6,728	8,910	1,214	$166,050,700
Forest development roads	75,212	30,350	19,440	25,422	45,076,100
Total roads	92,064	37,078	28,350	26,636	211,126,800
Trails	149,838	122,450	12,073	15,315	3,137,410
Total					214,264,210

TABLE 16.—*Construction, improvement, and maintenance of roads and trails from forest-road appropriations and other Federal and cooperative funds, by States, June 30, 1933*

State	Fiscal year 1933				Total to June 30, 1933		Expenditures to June 30, 1933		
	Constructed		Maintained		Constructed		Federal funds	Cooperative funds	Total funds
	Roads	Trails	Roads	Trails	Roads	Trails			
	Miles	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*			
Ala	4.1		182.8		71.4		$192,994.87	$25,278.16	$218,273.03
Alaska	3.0	69.6	242.1	494.9	250.0	587.2	6,537,803.23	377,947.35	6,915,750.58
Ariz	493.1	185.0	3,586.0	2,554.5	2,463.3	1,924.6	8,245,592.14	1,137,372.19	9,382,964.33
Ark	75.2		485.5	571.4	717.0	571.4	1,870,692.94	135,806.97	2,006,499.91
Calif	873.0	125.1	10,963.0	20,838.0	5,430.1	11,523.7	21,922,895.25	7,478,885.72	29,401,780.97
Colo	64.4	222.9	1,184.1	11,330.0	1,639.7	11,770.5	9,623,952.55	1,031,917.40	10,655,869.95
Fla	250.6		368.5		616.7		727,214.06	146,179.84	873,393.90
Ga	41.7	22.5	148.3	329.4	164.1	351.9	681,281.10	82,949.62	764,230.72
Idaho	708.7	1,798.0	3,895.7	28,186.0	3,374.1	20,388.1	20,378,132.12	1,888,154.58	22,266,286.70
Ill							441.41		441.41
Kans					3.4		2,111.54		2,111.51
Ky							808.72		808.72
La	63.7		90.2		153.9		48,853.58		48,853.58
Maine	3.0		8.5	74.0	10.4	67.2	81,091.87		81,091.87
Md							70.05		70.05
Mich	155.7		594.1		626.4		358,490.99	44,966.98	403,457.97
Minn	69.0		310.0	1,178.1	413.7	585.6	1,184,463.99	278,510.83	1,462,974.82
Miss	9.0				9.0		9,759.09		9,759.09
Mont	122.1	1,216.1	3,016.5	21,097.8	1,336.5	19,411.0	12,356,926.14	657,532.88	13,014,459.02
Nebr			75.9		51.5		119,481.03	990.80	120,471.83
Nev	30.5	5.3	334.0	1,183.2	558.9	920.4	2,107,475.07	168,271.95	2,275,747.02
N.H	10.0	27.5	308.5	580.0	71.6	580.0	600,987.33	95,949.70	696,937.03
N.J							217.71		217.71
N.Mex	180.4	36.3	1,923.6	3,377.5	1,361.5	1,634.8	6,246,452.10	330,825.54	6,577,277.64
N.Y							81.32		81.32
N.C	31.4	41.8	236.4	676.8	240.7	676.8	1,065,652.18	449,402.16	1,515,054.34
N.Dak					1.0		57.75		57.75
Okla	16.7		38.0	1.5	51.4	16.5	124,062.84	14,512.08	138,574.92
Oreg	553.5	634.5	9,444.1	15,524.0	4,756.5	8,666.4	18,695,93.59	7,893,300.39	26,589,235.98
Pa	4.9	178 8	97.6	23.0	72.0	201.8	322,081.66	42,185.50	364,267.16
P.R			4.6	36.3	6.6	36.3	35,445.02	550.00	35,995.02
S.C			13.0	18.2	6.3	18.2	114,672.71	15,659.81	130,332.52
S.Dak	14.6		281.2	54.5	355.3	85.1	1,198,650.54	244,046.11	1,442,696.65
Tenn	35.4	8.5	131.6	817.8	134.3	817.8	694,741.79	189,884.30	884,626.09
Utah	112.5	32.0	1,136.5	4,486.5	1,323.7	3,725.4	4,929,084.55	965,621.83	5,894,706.38
Vt	2.0		10.5	37.9	2.0		16,811.02		16,811.02
Va	106.6	10.1	224.7	917.3	243.1	927.4	936,880.80	106,400.35	1,043,281.15
Wash	256.0	766.7	2,470.0	14,117.0	1,781.7	8,502.0	12,351,723.70	1,713,530.02	14,065,253.72
W.Va	81.0	80.0	111.5	476.4	201.6	560.2	541,680.97	38,159.30	579,840.27
Wis	59.5		130.0		178.2		132,886.84	1,820.00	134,706.84
Wyo	23.4	53.0	972.0	6,256.2	1,098.4	2,541.3	6,112,646.93	397,382.96	6,510,029.89
Total	4,454.7	5,513.7	43,019.0	135,238.2	29,876.0	97,091.6	140,571,285.06	25,953,995.32	166,525,280.38

TABLE 17.—*Distribution among the States of the road and trail apportionments for the fiscal year 1934*

State	10 percent fund	Forest highways [1]	Improvement [1]	Total
Alabama	$58.94	$14,732	$49,000	$63,790.94
Alaska		350,000	60,000	410,000.00
Arizona	26,669.99	980,996	383,000	1,390,665.99
Arkansas	1,572.16	192,527	267,000	461,099.16
California	44,231.88	2,351,177	2,972,000	5,367,408.88
Colorado	34,297.66	1,217,346	274,000	1,525,643.66
Florida	1,479.52	63,763	19,000	84,242.52
Georgia	255.03	46,542	94,000	140,797.03
Idaho	26,041.84	1,710,825	1,052,000	2,788,866.84
Illinois		15,675		15,675.00
Kentucky		24,691	143,000	167,691.00
Louisiana	12.38	23,297	72,000	95,309.38
Maine	36.40	5,597	8,000	13,633.40
Michigan	234.39	94,966	168,000	263,200.39
Minnesota	968.06	157,300	150,000	308,268.06
Mississippi		34,709	93,000	127,709.00
Missouri		21,488		21,488.00
Montana	16,308.75	1,344,773	465,000	1,826,081.75
Nebraska	963.76	16,251	8,000	25,214.76
Nevada	6,496.97	312,310	6,000	324,806.97
New Hampshire	545.10	86,628	85,000	172,173.10
New Mexico	9,503.29	687,273	333,000	1,029,776.29
North Carolina	2,037.09	81,326	373,000	456,363.09
Oklahoma	464.00	22,078	24,000	46,542.00
Oregon	21,750.46	2,186,449	1,064,000	3,272,199.46
Pennsylvania	452.02	41,976	66,000	108,428.02
Puerto Rico	15.82	1,953	11,000	12,968.82
South Carolina	65.25	20,025	62,000	82,090.25
South Dakota	5,507.48	130,565	60,000	196,072.48
Tennessee	496.58	59,776	124,000	184,272.58
Texas		14,325		14,325.00
Utah	17,849.81	559,047	212,000	788,896.81
Vermont	33.80	8,334	49,000	57,367.80
Virginia	851.97	73,068	112,000	185,919.97
Washington	24,422.30	1,207,246	735,000	1,966,668.30
West Virginia	186.56	44,812	135,000	179,998.56
Wisconsin	26.23	60,442	109,000	169,468.23
Wyoming	16,508.81	735,712	163,000	915,220.81
Total	260,344.30	15,000,000.00	10,000,000	25,260,344.30

[1] $15,000,000 forest highways and $10,000,000 improvement made available under sec. 205 of the National Industrial Recovery Act.

TABLE 18.—*Distribution among the States of the total road and trail apportionments, including those for the fiscal year 1934*

State	10 percent fund	Section 8	Federal forest road construction	Forest highways [1]	Forest road development	Improvement [2]	Grand total
Alabama	$1,027.90	$15,456.04	$1,922.31	$74,506	$87,184	$80,077.06	$260,173.31
Alaska	170,809.45	470,963.60	203,229.50	6,645,184	249,114	60,000.00	7,799,300.55
Arizona	679,493.56	677,956.45	490,434.11	5,804,572	1,625,371	929,273.39	10,207,100.51
Arkansas	132,065.39	175,126.19	128,423.38	863,318	625,045	562,897.47	2,486,875.43
California	1,733,154.91	1,464,333.82	1,201,431.20	13,980,709	5,059,565	4,490,217.76	27,929,411.69
Colorado	810,895.24	770,948.34	784,259.55	6,862,938	1,892,233	459,629.09	11,580,903.22
Florida	46,053.86	119,528.14	21,534.94	293,622	171,835	159,417.47	811,991.41
Georgia	13,032.00	52,393.57	130,443.73	194,253	213,509	227,229.53	830,860.83
Idaho	1,014,099.53	1,176,750.85	1,337,004.17	10,318,588	7,275,982	2,879,886.55	24,002,311.10
Illinois				20,520	396		20,916.00
Kansas	1,867.27						1,867.27
Kentucky	722.72			24,691	86	143,000.00	168,499.72
Louisiana	57.62			31,090	10,586	110,132.47	151,866.09
Maine	3,980.03	32.41	3,738.77	28,332	28,866	29,909.56	94,858.77
Maryland	70.05						70.05
Michigan	4,310.72	115.63	3,000.00	191,591	122,644	332,507.86	654,169.21
Minnesota	45,013.65	8,036.36	108,352.03	669,521	374,148	280,348.59	1,485,419.63
Mississippi				40,276	5,487	101,598.45	147,361.45
Missouri				21,488			21,488.00
Montana	626,542.36	762,523.77	764,035.26	8,169,410	3,588,808	1,116,377.24	15,027,696.63
Nebraska	20,822.93	18.98		98,500	32,135	8,578.27	160,633.45
Nevada	189,508.66	192,989.88	81,491.85	1,918,765	162,343	51,878.18	2,596,976.57
New Hampshire	53,221.59	7,165.35	10,941.30	416,463	176,371	141,487.05	805,649.29
New Jersey	118.99				83		201.99
New Mexico	369,957.01	426,086.04	518,426.97	4,200,536	1,244,449	741,824.28	7,501,279.30
New York	4.00				20		24.00
North Carolina	40,993.19	86,336.41	176,466.28	311,105	342,843	565,530.92	1,523,274.80
North Dakota	45.75	7.00					52.75
Oklahoma	11,163.75	65.49	2,775.17	62,385	42,705	59,700.19	178,794.60
Oregon	1,071,397.44	1,428,785.95	1,013,981.59	12,580,038	5,118,492	1,940,916.07	23,153,611.05
Pennsylvania	5,889.32	7,724.04	21.42	146,039	153,145	145,976.40	458,795.18
Puerto Rico	150.44	7.00	3,343.09	11,841	17,005	15,714.52	48,061.05
South Carolina	3,253.68	402.10	48,028.61	45,585	49,408	62,171.08	208,848.47
South Dakota	193,026.19	87,106.45	78,652.52	770,493	228,313	93,879.18	1,451,470.34
Tennessee	21,120.59	106,854.56	27,967.79	252,355	237,917	224,304.31	870,519.25
Texas				14,325			14,325.00
Utah	435,176.35	464,918.34	512,489.56	3,424,581	734,388	395,090.76	5,966,644.01
Vermont	34.40			13,740	829	59,778.15	74,381.55
Virginia	48,165.76	58,390.16	71,784.26	329,588	340,797	266,268.85	1,114,994.03
Washington	704,313.75	958,090.33	732,302.49	6,982,812	3,847,220	1,596,091.47	14,820,830.04
West Virginia	6,331.44	12,830.41	5,049.24	148,235	193,779	343,604.94	709,830.03
Wisconsin	63.25			83,493	29,754	207,415.88	320,726.13
Wyoming	479,970.56	468,056.34	538,468.91	4,454,512	1,217,145	265,815.87	7,423,968.68
Total	8,937,925.30	10,000,000.00	9,000,000.00	90,500,000	35,500,000	19,148,528.86	173,087,032.43

[1] Includes $3,000,000 appropriated for emergency highways within national forests, fiscal year 1931, and $5,000,000 emergency forest highways, fiscal year 1933, and $15,000,000 for forest highways under the provision of sec. 205 of the National Industrial Recovery Act.

[2] Includes (a) road and trail actual expenditures from Agricultural Appropriation Act annual funds and (b) $10,000,000 improvement funds under the provisions of sec. 205 of the National Industrial Recovery Act.

TABLE 19.—*Condition of forest-road funds on June 30, 1933*

Fund	Appropriations	Expenditures	Balance
10 percent	$8,677,581.00	$8,282,223.87	$395,357.13
Sec. 8	10,000,000.00	10,000,000.00	
Federal forest-road construction	9,000,000.00	9,000,000.00	
Forest highways [1]	68,960,000.00	65,272,239.19	3,687,760.81
Forest-road development	35,500,000.00	34,150,477.20	1,349,522.80
Improvement [1]	9,148,528.86	9,148,528.86	
Total	141,286,109.86	135,853,469.12	5,432,640.74

[1] Includes emergency funds.

The last two agricultural appropriation acts have limited to $350,000 the expenditure in Alaska from the forest-highway appropriation. Previously the Alaska apportionment was approximately one tenth of each forest-highway authorization.

Since no legislation was enacted authorizing forest-road and trail appropriations for the fiscal year 1934 under section 23 of the Federal Highway Act, appropriations for the regular forest-highway and forest-road-development funds were limited to the balance left in the 1933 $12,500,000 authorization. Only $2,082,600 now remains unappropriated, practically all of which has been obligated for construction and maintenance projects.

On March 21, 1933, the President issued instructions to "cease obligating all or any part of the unobligated funds which involve construction work." This caused the immediate cessation of all work for which financial obligations had not been entered into. After discussions and conferences the Bureau of the Budget decided that a total of $2,705,045 was affected. It was made up of $1,595,245 forest-highway funds, $287,900 forest-road-development funds, $548,100 emergency-improvement funds, $180,000 10-percent funds, and $93,800 improvement funds. On June 13 word was received that the President had lifted the stop order on forest highways and authorized the resumption of approval of road projects and of entering into contracts.

On June 16 the National Industrial Recovery Act was signed. It provided, under section 205, that "not less than $50,000,000 of the amount made available by this act shall be allotted for (*a*) national forest highways, (*b*) national forest roads, trails, bridges, and related projects, (*c*) national park roads and trails in national parks owned or authorized, (*d*) roads on Indian reservations, and (*e*) roads through public lands, to be expended in the same manner as provided in paragraph (2) of section 301 of the Emergency Relief and Construction Act." Allotments of $15,000,000 for national-forest highways and $10,000,000 for national-forest roads, trails, bridges, and related projects have been made. Of the $15,000,000, $350,000 was apportioned to Alaska and the rest to the States and Puerto Rico on an area and value basis as prescribed in the rules and regulations for administering the forest-highway fund. This money will be programmed to individual road projects by the Secretary of Agriculture after receiving the recommendations of the interested State highway commissions and representatives of the Bureau of Public Roads and the Forest Service. The $10,000,000 fund was divided among States in accordance with the regional foresters' estimates of needs during the next 2 years for the immediate construction and maintenance of improvement roads, trails, and bridges. This work will be in addition to that done by the Civilian Conservation Corps, which in many cases cannot be utilized on projects of the highest priority because of the limitations necessarily imposed by the size of the camps and whole plan of organization.

The creation of the Conservation Corps made available for construction and improvement work a large though inexperienced force of young men, who required much supervision and instruction. All told, 597 camps of 200 men each were located on the national forests. The services of the corps were largely and extensively utilized in the construction and improvement of forest truck and horse trails. After making available all the equipment which could be spared from the regular Forest Service work and surplus equipment in other departments, about $1,000,000 had to be spent for the purchase of tractor trail builders, tractors, graders, and compressors.

MAPS AND SURVEYS

For administrative use the Forest Service published 19 quarter-inch scale maps, 19 half-inch scale maps, and 4 inch-scale maps of the individual national forests. There were also published 2 maps to accompany Presidential Executive Orders, 23 small editions of miscellaneous maps, charts, tables, graphs, and illustrations, and 3 United States Geological Survey quadrangles showing in color tints the vegetative types.

The Forest Service personnel completed surveys on mapping projects covering about 1,500 square miles. This mapping was done on scattered areas, to the accuracy and scale required to meet special requirements of forest administration. Drainage maps covering approximately 3,000 square miles were completed by aerial methods.

RESEARCH

Some curtailment of the regular research activities was necessitated by the falling-off in the available funds shown in table 20. A greater cause of interruption in the orderly prosecution of the long-time program was the demand made upon the research organization by the Copeland report. The execution of this monumental task was a Service-wide undertaking, but its planning and direction and the largest share in the actual work fell to the Branch of Research. In the assembling of the field data the 11 forest and range experiment stations played the leading part. Organization of the entire inquiry and preparation for obtaining the necessary data had been completed before the opening of the fiscal year. The raw material for the report reached Washington in September and October. To assist in its digestion, in the working up of the factual sections, and in the final formulation of the findings and recommendations derived from them, a considerable number of the ranking officers of the Service field force and the experiment-station staff members were brought into Washington for varying periods. An enormous amount of overtime work was done, and the whole project was carried on under high pressure up to the time of its termination in March. Only through the loyal and devoted cooperation of many men and women both of the professional and administrative and of the clerical force was the completion of this great task within the permissible time limit made possible.

The funds made available for research activities under various appropriation items for the fiscal year 1933 are shown in comparison with the amounts for 1932 and 1934 in table 20.

TABLE 20.—*Appropriations available for research for 1933 as compared with those for 1932 and 1934*

Class of research	1932	1933 [1]	1934 [1]
Forest-management investigations	$562,000	$497,181	$378,468
Forest-products investigations	641,300	556,425	435,407
Range investigations	130,000	111,922	76,820
Forest-economics studies	75,000	64,692	46,092
Forest survey	200,000	157,221	122,963
Forest-taxation study	70,200	38,023	25,267
Forest-insurance study	10,000	12,000	7,840
Erosion stream-flow studies	100,000	82,973	64,386

[1] The amounts shown in these 2 columns are the amounts made available by the Agricultural Appropriations Act less the amounts withheld under the provisions of the Economy Act and by the Bureau of the Budget.

FOREST ECONOMICS

The preparation of the portions of the Copeland report falling particularly within the field of forest economics was the outstanding activity of the year in that field. The work done included: A general review of the national significance of and reasons for forestry; a survey of the status of private forestry and opportunity for its further development; an analysis of the theories and principles of public regulation of private forests, its status in other countries, and a possible program for public regulation in the United States; an examination of the need for public assistance in organizing credit facilities for forest enterprises; a study of national timber requirements, together with an analysis of world requirements in relation to United States timber supplies and needs; and a comprehensive

investigation and analysis of the best data available on the present and potential forest resources of the United States and of individual forest regions, including forest areas, timber supplies, rates of depletion and growth, ownership of forests, and related matters. These contributions have all been published in the form of separates.

The results of the exhaustive time and cost studies, completed in 1932, of virtually all types of logging equipment and methods employed in the Douglas fir region were interpreted and made available to the industry in various ways, and a report was completed for publication. By changes in methods it is possible in many instances to save $2 or more per thousand board feet in the cost of logging, while also perpetuating and improving the forest. A second report, correlating these and other findings with the variations in value which are determined by age and size of timber, is being prepared. The facts developed by these studies are of the utmost importance for improved forest management in the Douglas fir region.

The continuing investigation of the financial aspects of forestry in the southern pine region brought out strongly the financial and silvicultural advantages of selective logging in virgin and second-growth stands of loblolly and shortleaf pines and hardwoods. Further evidence was developed of the financial practicability of private forestry on many tracts in the region.

The study of "the new public domain", that is, forest land which is reverting to public ownership through tax delinquency, was continued in the Lake States, the South, and the Pacific Northwest. A chapter on tax delinquency and the cut-over-land problem in northern Minnesota was contributed to the book on Taxation in Minnesota published during the year by the University of Minnesota, and the data were also used by the Governor's committee on land utilization. Study was begun of the Upper Peninsula of Michigan, where the area of delinquent land is large and increasing. In Arkansas, a study of tax delinquency in relation to land use in representative counties was completed in cooperation with the State university. Investigations in the Douglas fir region of western Oregon and Washington showed that the extent of reversion to public ownership is far greater than has been supposed. Tax delinquency and land abandonment there are causing acute difficulties to agencies which depend on tax revenues, and the delinquent areas are becoming a serious hazard to contiguous timber properties.

Actuarial studies of the problems and possibilities of forest-fire insurance in the Douglas fir region and in the ponderosa pine region of the Northwest were completed. Records of stumpage and log prices in all forest regions for the years 1931–32 were compiled and prepared for publication.

FOREST SURVEY

The field work and most of the office work on the inventory phase of the forest survey of the Douglas fir region were completed. This makes available for the first time a complete set of data accurately localized by counties and by major ownership groups, showing the volume of timber by species and the acreage of all classes of forest growth and of cut-over and burned-over forest land. An investigation of the average rate and trends of depletion of both old and young timber by fire, cutting, and other causes was practically completed. Work is also well under way on a study of the region's requirements for forest products.

In the South, the inventory of the Delta hardwood unit of Mississippi, covering 4,420,000 acres, was completed and is being prepared for publication. Field work was also completed for the northern Mississippi unit of upland pine and hardwoods (8,154,000 acres), and was commenced in the central Mississippi unit. In all, approximately half of the State has been surveyed.

The survey of several counties in northern Idaho was virtually completed. Surveys of two counties in Michigan and one in Wisconsin, aggregating nearly 2,000,000 acres, were made in cooperation with the State agencies. These surveys include forest maps, timber estimates, and studies of growth rates. In California, the mapping of forest-cover types was continued in cooperation with the national-forest administrative force, the State, the United States Geological Survey, and the National Park Service. Maps of four quadrangle units, on a Geological Survey base, were published, and others are in preparation.

Studies of the requirements of wood for urban construction were made for a number of representative cities well distributed in nearly all of the different forest regions.

FOREST TAXATION

In view of the widespread interest in the problems of forest taxation and the many requests for suggestions as to desirable changes in systems of forest taxation, summarized conclusions and recommendations of the Forest Taxation Inquiry with regard to four specific forms of forest taxation were made available as a mimeographed progress report (no. 18), which was given wide distribution.

FOREST MANAGEMENT AND PROTECTION INVESTIGATIONS

During the year many agencies, public and private, obtained help from the forest experiment stations. Administrative organizations were aided in meeting problems due to curtailment of funds, or regarding the best use of funds for improvement programs. Many such problems arose in connection with planning for the work of the Civilian Conservation Corps.

FIRE-CONTROL RESEARCH

Continued studies relating to fire control furnished a more complete basis for protection planning. Previous investigations had established bases for determining the relative damages caused by fire, the rate of spread of fire, the probability that fire will start, and the difficulty of fire suppression. A study of the detection system used on the national forests disclosed that extensive areas on which fires reach large size are often not sufficiently commanded by the look-out stations. A method was devised for locating blind areas and ascertaining the relative value of different look-out points. Many forest officers were given special training in this method on the experimental forests, and are now putting it into practice. In one region, before any look-out house is erected the plans for the detection system are reviewed by the forest experiment station.

The present detection system is based on the assumption that the range of dependable vision for look-outs is 15 miles. Observations as to the visibility of some 450 natural targets, made at 15-minute intervals each day throughout the fire season, showed this assumption to be dangerous because of haze, shadow, and drift smoke. Smoke tests disclosed that the character of the background against which a smoke rises influences visibility more than distance. Under ordinary conditions test smokes could consistently be seen quickly only within a distance of 7 miles; but in one case smoke 24 miles distant was discovered in 1.5 minutes, while in another the detection time required for a look-out only 5 miles distant was 13.1 minutes. Many other wide variations in the distance at which fires are visible and the elapsed time before their discovery were revealed.

A method has been worked out for rating fire hazard, taking into consideration the inflammability of the forest type, the quantity and character of the fuels, the slopes, etc., and analysis of the records of thousands of past fires has afforded a determination of the speed of attack necessary, for various degrees of hazard, in order to keep fires small. This is furnishing the basis for the location of many protection roads and trails. It has also been found that without adding any men, roads, or trails, the efficiency of the first line of defense against fire can be increased for the whole of a national forest by from 3 to 8 percent by relocating look-outs and firemen. This has made possible savings amounting to thousands of dollars for a single national forest.

A device called the fire-danger meter has been developed in the Northern Rocky Mountain Region, which gives an integrated rating of the combined effect of fuel inflammability, air humidity, wind velocity, visibility, season of the year, and other factors involved. This makes it possible to determine quickly the probable rate of spread of fire and the administrative action needed to cope with the danger. A practical eye test devised to determine the fitness of candidates for look-out duty has served to weed out those disqualified. The study of the vision of look-out men resulted in the recommendation that all look-outs be furnished with binoculars, and a careful study was made of all available binoculars, with Army and Navy help. The binoculars used by the Navy were found to be the best for the type of work to be performed.

GROWTH AND FOREST-PRACTICES STUDIES

A new method of estimating growth in selectively cut stands promises to prove one of the most far-reaching accomplishments in many years. Developed for ponderosa pine by W. H. Meyer, of the Pacific Northwest Forest Experiment Station, it can probably be applied to other species growing under comparable conditions. It enables the forest manager to calculate how heavily he should cut to obtain the greatest possible subsequent growth, and approximately when he can

cut again. A by product of this study was the discovery that climatic cycles result in wide variations in growth rates, which may seriously disrupt forest-management plans unless proper allowance is made for them.

Results of past investigations in stand-improvement measures, such as thinnings and liberation and improvement cuttings, have been drawn upon in developing the Civilian Conservation Corps program. A publication dealing specifically with stand improvement in the eastern hardwood forests was prepared. It set forth what kind of treatment is required for stands in various conditions to make them fully productive, how to choose crop trees to form the nucleus of the future forest, and what procedure to follow in liberating crop trees so that they will produce wood of high quality. Similar publications are in progress on stand sanitation in the eastern forests and on stand improvement in the southern pine region.

Studies in the redwood region of California indicate that under destructive logging and the slash-burning methods now generally used, even planting cannot bring about satisfactory stands of young growth on any large percentage of the logged area. Redwood reproduces well from seed under proper conditions, and it appears feasible to leave seed trees, as a rule; planting should be necessary only where too dense a ground cover has become established to permit natural reseeding.

Data gathered on the viability of seed stored in the heavy litter and duff of the mature forest in the western white pine region of north Idaho showed a germination of slightly more than 40 percent of the seed stored 1 year, 23 percent of that stored 2 years, and 1 percent or less of that stored 3 or more years. Seed of six other species gave less than 1 percent germination after 1 year, and nothing subsequently.

Much of the tree planting on farms in the Central States has been of the valuable black walnut. Tentative conclusions based on work in eastern Illinois are that walnut planting cannot be successful if the subsoil is tight. Poorly drained land is also poor walnut land. The growth of walnuts on brown silt loam was good, in contrast with that on black clay loam heavily infiltrated with organic matter.

At the end of the 1932 chipping season the Starke, Fla., branch of the Southern Forest Experiment Station was permanently closed. Here, for 10 years, were conducted most of the turpentining practices investigations in cooperation with various private forest owners. The establishment of the Osceola National Forest, with its experimental forest recently provided, makes it possible to correlate the naval-stores investigations with those in other phases of forest management.

EXPERIMENTAL FORESTS AND NATURAL AREAS

Five new experimental forests, ranging in size from 3,400 to 7,000 acres, were formally set aside. All were in the West. The experimental forests are becoming more and more demonstration centers as well. Some serve as training grounds for national-forest personnel in such fields as forest management, stand improvement, fire control, and reforestation. A larger number are needed. The development of a complete system is held back, especially in some of the more valuable forest types, by the absence of suitably located national forests. Particularly needed are experimental forests in the loblolly pine region of the Coastal Plain, the shortleaf-hardwoods type of the piedmont region, the white oak-poplar forests of the Cumberland Plateau and the Ozark region, the oak-hickory type of the Central States, and the bottom-land hardwoods type of the Southern States. In the West the greatest need is in the redwood region of northern California and in the spruce-hemlock region of the north Pacific coast. Hope for a partial solution is afforded by the acquisition program now under way in the East.

Five new natural areas were set aside. The smallest area was one of 640 acres of ponderosa pine, and the largest was one of 4,230 acres in the alpine type of the Sierras. So far 18 natural areas have been set aside, of which only 3 are in the East. The eastern national forests are made up mostly of cut-over lands and very little old-growth forest suitable for setting up natural areas has been acquired. The preservation of representative old-growth stands containing such species as tulip poplar, red and white oaks, hemlock, southern pine, cypress, and red gum is greatly to be desired.

EROSION-STREAM-FLOW INVESTIGATIONS

The study of erosion and stream flow made in connection with the Copeland report revealed that practically every part of the country has one or more serious problems to meet relating to such matters as water for domestic and industrial purposes and irrigation, water power, navigation, floods, and soil erosion. Marked changes are taking place in the regimen of many streams. Undesirable soil movement is taking place on great areas of watershed land. Both are largely the result of improper use of forest, range, and farm land. Almost three fourths of

the total forest area of the United States was classified as having major or moderate influence on watershed values. The varied and complex influences of climate, forest type and condition, and character of soil on stream flow and on erosion must be carefully determined if forest-land management is to meet watershed-protection requirements.

Application of research results was given great impetus during the year. The Civilian Conservation Corps has 97 erosion-control camps on national-forest lands and 104 erosion-control and 20 flood-control camps on State and private lands. The main purpose of this work is to restore forest or other cover where its depletion has been the cause of accelerated erosion or excessive run-off and to supplement this plant cover by check dams or other engineering works to retard water flow and to aid in holding soil. Research results have furnished the basis for much of this work. The studies of the Southern Forest Experiment Station in reclaiming gullies on abandoned farm lands in the South have helped to show how under certain conditions the planting of black locust and other trees and the use of vines and other creeping plants or grasses can be used to check further erosion and to restore the land to a productive condition.

The California Forest Experiment Station made extensive test seedings on a large burn in the southern coastal range of the State. In the fall of 1932 a 219,000-acre fire destroyed the forest and other cover on large portions of the watersheds furnishing the water supply for Santa Barbara, Montecito, Ventura, and many smaller agricultural and other communities. On 4,000 acres 18 tons of seed were broadcast by hand, and on 2,000 acres 9 tons were sown by airplane. The results with Trieste mustard are outstanding. It formed a satisfactory cover on good soils from a sowing of about 4 pounds per acre. Black mustard required 5 pounds or more to produce a satisfactory stand. Both species had attained a height of 24 to 40 inches and had produced fruit by the spring of 1933. White and sour clover averaged less than 6 inches in height. Gullies, formed by a heavy January storm before active germination, are now conspicuously marked by dense growth of control plants blocking the run-off channels. Comparable areas seeded by airplane show results in general similar and equal to those on hand-sown areas. There is, however, a decided scarcity of plants on most of the higher and steeper slopes, where violent winds lifted away the loose, fine soil and excessive drying took place.

The California Forest Experiment Station also superintended application of its research results to extensive plantings of brush and other vegetation, supplemented by contour furrows and other aids, on cuts and fills of a number of California mountain highways. Checking the erosion of these exposed slopes reduces both highway-maintenance costs and depositions of eroded material on valuable property.

Study of the relation of roots of native plants to erosion control on the Boise River watershed was continued by the Intermountain Forest and Range Experiment Station, in cooperation with the University of Idaho. Twelve important species of grasses and weeds were excavated and studied intensively. The weed root systems had a low soil-protection value. The one annual grass and the two perennial grasses so far excavated have very fibrous and well-branched roots, which bind the soil immediately around the base of the plant into a firm mat. The perennial grass species have tougher and more extensive roots than the annual cheat grass, but on depleted ranges the latter in favorable years often attains a density of 1,000 plants per square meter, and therefore serves advantageously in holding soil on slopes.

The superior physical condition and consequent permeability of forest soils has been demonstrated for Ohio Valley conditions by studies of the Central States Forest Experiment Station. Samples of the upper 9 inches of soil under several old-growth stands in oak-hickory and other hardwood types were found to be 13 percent lighter at oven dryness than equal volumes of soil from adjacent cultivated fields and a few pastures—indicating more pore space and better tilth. This difference was chiefly in the upper 6 inches. At a 3-inch depth 14 times as much water was absorbed per minute by the forest as by the field soil, and at a 1-inch depth more than 50 times as much.

The ability of old-field pine stands on abandoned fields in the southern Appalachian region to improve the physical structure of the soil and retard surface run-off has been demonstrated at the Appalachian Forest Experiment Station. Abandoned fields required 58 times as long as virgin-forest soil to absorb the same amount of precipitation. Old-field soils supporting a 25-year-old stand of shortleaf pine required only four times as long as virgin-forest soils to absorb the same amount of precipitation. Removal of litter for three successive seasons from an old-growth yellow pine-hardwood stand reduced its porosity and thereby increased surface run-off from 10 to 20 times.

FOREST-PRODUCTS RESEARCH

Logs, lumber, wood, and woods products are staples of American consumption and commerce. Upon the continuance and healthy growth of the commercial demand for forest commodities depend the permanent employment of many thousands of men and the restoration to economic use of vast areas of land now idle. Research in forest products operates toward broadening and stabilizing forest markets. By promoting maximum efficiency in harvesting and using forest stands and adapting them to modern needs, it seeks to safeguard the economic future of forestry. Never was the need greater. Plans for more rational and orderly land use will surely call for an enlargement of forest areas and forest productivity as a vital part of the program. If these plans succeed, the country may look forward to substantial replenishment of forest raw materials. All the important industries of the country are increasingly recognizing the vital relation of scientific research to modern markets. Now is the time for forest-products research to play its fullest part in shaping nation-wide forestry into a nation-wide economic asset—in showing the way to profitable and permanent standards of logging practice, in securing output of the greatest service value, in adapting the material to advancing engineering, structural, and manufacturing requirements, in developing new uses for wood, and in the formulation of industrial codes that will as far as possible insure these gains in practice.

The Forest Products Laboratory is the center of Forest Service research in the field broadly embraced by forest consumption and markets. The account given below of some of its major activities during the past year will show their important bearing on the present problem of economic forest utilization.

Approximately 70 percent of the country's normal hardwood requirements of 7,000,000,000 board feet a year comes from the South. Logging has cut heavily into the stand of preferred species, leaving large stands of other species unused and many areas in a poor state of productivity. A crisis is in early prospect, threatening further loss of employment in hundreds of communities and the passing of thousands of square miles of land from economic production. A broader basis of species utilization is an outstanding need. A great profusion of species is inadequately used, for the most part, because of lack of definite knowledge of their manufacturing and service qualities and a generally low estimate of their commercial possibilities. Regional and national hardwood-producing groups have repeatedly asked for a technical study of the southern species, and the Forest Products Laboratory this year began an investigation of the problem in its various phases, from the growth of the tree to the machining properties of the wood.

A number of forest stands and mill operations in the Gulf States and Arkansas were studied, and some 5,000 growth samples and 10,000 samples of the lumber of 18 lowland hardwoods were collected, along with detailed site descriptions. Information obtained from plants manufacturing furniture, refrigerators, automobile bodies, and other hardwood products indicated the relative industrial importance of the properties to be studied. The immediate work is concerned with determining the shrinkage and warping characteristics of the various woods, their specific gravity and rate of growth, and their hardness and type of grain—features that can be brought under control through practical measures of selection and segregation according to properties desired by the user. The program includes also investigation of the woodworking qualities of each species on the laboratory's shop machinery. Information to guide forest growing and management in these species is being sought through correlation of the wood properties and structure with crown size of the trees, with soil conditions, and with depth and duration of flooding on the site.

The selective logging of southern hardwoods was studied at two locations in virgin timber in the "first bottom" of the Mississippi River. The investigation was merely an introduction to the work necessary to establish a basis for selective cutting that will favor efficient and permanent operations in such stands, which constitute a highly complex forest type. On the sites selected, some 20 different species of hardwoods were encountered. Preliminary work was also done toward the development of log grades, a matter of high importance in proper cutting and marketing of the stand. A number of air-seasoning test piles of lumber were set up to obtain fuller data on grade yields and returns.

Problems of the small mill cutting southern hardwoods were given particular attention. Operators were assisted in improving standards of production and equipment and in the more uniform grading of their output. Kiln-seasoning investigations were centered on the refractory southern swamp oaks, in which drying defects offer the greatest obstacle to use. The problem was attacked

on new lines, with good results. It was found practicable to process and dry 1-inch boards of these species in 2 weeks to a moisture content as low as 5 percent, with no checking and with less degrade and shrinkage than when seasoned by ordinary methods. The rate of drying is about three times as fast as that accomplished in the best current kiln-drying practice. Other promising discoveries were made. Further work must be done, but the way is open to methods of drying that may release millions of feet of unused hardwoods for satisfactory service.

WOOD IN CONSTRUCTION AND FABRICATION

Lumber for building and manufacturing purposes accounts for half the total timber cut, and large additional amounts are used for railway ties, poles, piling, and the like. Improvements in wood use for these purposes offer broad and direct benefits to economic forestry, forest markets, and forest land use. The laboratory continued its research on wood as a structural material, looking toward the modernization of building practice through the use of composite members and parts and through basic improvements in timber engineering. Arches afford one of the most effective means of carrying loads in a building so as to get large clear floor areas, but in this country its use in wood construction remains undeveloped. Laboratory tests demonstrated the safety of laminated arches, which can readily be made to any curvature, and showed that in most instances the stresses resulting from the bending of the laminations to curved form do not appreciably reduce the load-carrying capacity. Further study is concerned with the effect of end joints on the strength of the arch, the possibility of using low-grade material for certain laminations, and methods of simplifying design.

The increasing use of plywood for engineering and construction purposes has created need for data on methods of calculating plywood strength. An approximate method of calculating the bending strength of Douglas fir was developed and supplied to the industry by special request. More accurate formulas for the strength, stiffness, and other engineering properties of plywoods are expected from comprehensive studies now under way.

The proper selection of lumber for specific uses has long been handicapped by technicalities and nonuniformity in commercial grading rules. The laboratory took a long step toward remedying the confusion by submitting to the industry a simplified and uniform basis for the development of lumber grades for all commercial softwood species, to meet better the needs of architects, builders, and home owners on a basis of use requirements. A guide was also prepared for the purpose of clarifying American lumber standard provisions for the grading of structural timbers. The revaluation of the shearing strength of large beams which has been accomplished by analysis and test of the effect of seasoning checks was adopted last year in standard specifications for bridge timbers, with large potential economies of material.

There was published a bulletin on the laboratory's investigations of the bearing strength of bolted wood joints, which amounts to a practically complete revision of engineering data on this critical design factor. Another bulletin, presenting the results of tests made in cooperation with the National Committee on Wood Utilization on a variety of modern metal connectors, made available working data which point the way to increased efficiency of construction, simplified shop fabrication, and rapid erection. A circular on the efficient design of wooden crates was issued. A much larger publication, now practically ready for press, is a handbook of wood construction and use that brings together for the first time the available information in this whole field, from the laboratory and other sources. A handbook dealing in simplified terms with wood construction on the farm is also nearing completion. A report on special studies of the strength and other properties of redwood was published as a bulletin, and a revised summary of the strength of the principal American wood species is in preparation.

PULP AND PAPER

The home market for pulp and paper offers outstanding opportunities for utilizing more American land and labor. More than half our consumption of pulp and paper depends ultimately on imports of foreign pulpwoods and their products. The present challenge is for more efficient, economical, and satisfactory production of pulp and paper from native stands now existing—stands that can be made self-replacing under profitable use.

The laboratory's pulp and paper investigations have contributed to the increasing use of such species as the pines, hemlocks, Douglas fir, and certain hardwoods. Between 1920 and 1930 the percentage of domestic spruce and balsam fir used in pulp production fell from 58 to 36 percent. Last year's work had to do in part with woods such as Douglas fir and the southern pines, which on account of their resinous character are usually regarded as proper material only for the sulphate or kraft process. Experiments with the new soda-base and ammonia-base processes resulted in true sulphite pulps of satisfactory strength and bleaching quality from those abundant woods. A new and promising source of tissue papers, which stand high in tonnage consumption, was found in western hemlock pulped by the standard sulphite process. The finding that finely broken up wood can be satisfactorily pulped if proper circulation of liquors in the digester is provided for has special significance in relation to the possible pulping of vast quantities of sawdust waste.

The utilization of semibleached sulphate pulps to replace unbleached sulphite in newsprint production was successfully applied to Florida sand pine, which shows excellent possibilities as a pulpwood. Strong white papers, newsprint, and specialties such as greaseproof and glassine were also made from Monterey pine by the laboratory's sulphate pulping and bleaching process.

Why ordinary sulphate pulping yields a dark product difficult to bleach has hitherto been unknown. A fundamental study now in progress may furnish the solution and also furnish important results for practical application. Investigation of the several possible sources of dyestuffs in pine-wood sulphate pulps definitely linked these discoloring materials to the so-called phlobatannins and their condensation or oxidation products, the phlobaphenes. The phlobatannin derivatives are also probably responsible for the reddening of sulphite pulps. Further work on larger amounts of the dyes should establish their exact identity.

CHEMICAL AND PHYSICAL PROPERTIES OF WOOD

Progress in the utilization and conversion of wood is bounded ultimately by our knowledge of the wood as a complex of chemical parts and as an organic structure shaped by varying conditions of growth. Further research in the chemistry of wood gave a broader and somewhat simplified view of its constituents. Considering the total extractive-free wood substance, the new term "holocellulose" was introduced to apply to the whole carbohydrate content, covering into one group the stable cellulose and the so-called "hemicelluloses" and other sugarlike bodies related to it. The remaining substance is designated simply as lignin. This is not merely a revision of terminology. Means of separating wood into these two distinct divisions were developed so as to account for all the material with little or no degradation. Clues obtained in the work point toward a possible new means of delignification of wood that may give higher yields of useful pulp than are now common.

The isolation of lignin in apparently pure form by the use of sulphuric acid at low temperatures measurably simplifies the problem of its composition. In hardwood lignins at least three different kinds of hydroxyl groups were found. Acetyl groups, the source of acetic acid, were shown to exist only in the holocellulose. Methoxyl groups were found to lie chiefly in the lignin, but not entirely in the lignin as formerly supposed. In hardwoods an important portion, amounting to some 26 percent of the total methoxyl, was traced to the holocellulose.

Investigations of the chemistry of extractives threw further light on their properties. Two phenols, in a liquid and a crystalline form, were isolated from western red cedar. The latter was found about equal to mercuric chloride (corrosive sublimate) in toxic effect on test fungi. An attempt will be made to determine its exact composition, which may afford the basis for a new and effective wood preservative. Completion of the study of ether extractives of the southern pines, with particular reference to their influence in pulping processes, added considerable information on both the chemical composition of these materials and their distribution in the tree. Work of the laboratory on the ether extractive of Douglas fir and ponderosa pine and on the water-soluble extractive of redwood proved useful to the termite-investigations committee in their experiments on the relative resistance of the two woods to termite attack. The laboratory's data on the distribution of extractive in redwood are included in the committee's report.

Study of environmental factors as affecting the growth, structure, and properties of wood was continued. Previous findings regarding means of controlling summer-wood production in the southern pines were amplified by a study of spring-wood production. An explanation of the increasing proportion of spring wood with increasing height in the trunk is being sought on the basis of the size and activity of the tree crown in the supplying and translocation of food. A

bulletin on the causes of brashness in wood and its elimination through selection and growth control was issued, and a report on the occurrence, structure, and properties of compression wood was prepared for publication.

To assist in the determination of forest-fire hazards under varying weather conditions, a new type of "fuel hygrograph" was developed and built in cooperation with the Northern Rocky Mountain Forest and Range Experiment Station. This instrument measures and records wind velocity, duff moisture, and the moisture content of a group of wood samples representative of small tree limbs.

The prolonged drought of 1931–32 in the Southeastern States afforded an excellent opportunity for observing drought effects on oleoresin production in the pines. Microscopic examination of the inner bark or phloem revealed that darkening and pitch soaking were the definite precursors of dry-facing. Continued heavy turpentining after this stage often resulted in the death of trees, but when chipping was stopped or light chipping practiced the trees generally recovered and maintained production. This indication was an incidental finding in the study to connect biological or growth factors with the formation of oleoresin, the raw material of naval stores. The progress made encourages the hope that high-yielding trees can ultimately be distinguished from low yielders in advance of chipping, and that high-yielding strains may be further developed.

RELATED INVESTIGATIONS

The preceding condensed review of leading laboratory projects has passed over much of importance, some of which calls for brief mention.

It should be stated that all the work of the laboratory is greatly benefited by its transfer, now complete, to the new, large, and modern building erected for its uses by the Government on a choice site donated by the University of Wisconsin.

Intensive investigations were begun looking to facilitation of an integrated industrial set-up founded on sustained yields of naval stores, lumber, and pulp from the slash-longleaf type of forest. A report on previous studies of logging and milling in the loblolly pine forests of North Carolina was published in bulletin form. A new study of commercial air seasoning of long-leaf pine and further study of the problems involved in lumber storage added to practical knowledge relating to moisture removal and control. Reports on the regional investigation of moisture content of wood in dwellings and on the specific gravity and related properties of commercial softwood lumber were issued as departmental publications. Progress was made in the design and testing of new types of glued laminated joists and dowelled joists. A way was found to decrease the weakening effect of notching joists where they are supported by the girders. Various types of fasteners were studied, the tests being particularly directed toward filling in gaps in the data on nails, screws, and drift pins.

The creosote treatment of southern pine poles, the effects of heating on wet wood, and two chemicals of considerable promise as wood preservatives were studied. One of these chemicals, dichloralphanaphthol, is highly toxic to fungi, is odorless and colorless, and is therefore suitable for the treatment of construction timbers on the inside of buildings, wood parts of automobile bodies, and the like. A report of the laboratory's researches on the toxicity of chemicals to living organisms was published as a technical bulletin. Substantial progress was made in the development of new fire-retardant treatments for wood. In continuation of the study of paint behavior, it was found that none of the extractives occurring in American commercial softwoods seriously affect the durability of the coating unless present in large amounts or under exposure to excessive moisture. An investigation of the priming of lumber at mills, a recent commercial development, showed that higher grades of paint materials than are now used are necessary if any considerable degree of moisture exclusion is to be obtained by a single application.

In the sulphate pulping of Douglas fir and the soda pulping of loblolly pine the effect of two different ratios of chemical to wood was studied. A new study of ground-wood pulping variables was undertaken. The work thus far indicates that fiber length of the pulp increases with the temperature, the resultant effect on quality being noted principally in an increase in tearing strength. An increase in the temperature also appears to cause a decrease in power consumption and an increase in production rate. Other useful accomplishments in pulp and paper research were determinations as to the colloidal nature of the "hydration" and fiber characteristics of beaten pulp, an evaluation of starch gum as a sizing material, detailed improvements in methods and apparatus for the evaluation of fibers and papers, and the further development of control apparatus for stuff preparation and papermaking processes.

RANGE RESEARCH

The value of range research has been strikingly shown during the past year. It aims to determine how to produce and utilize forage on range lands most effectively. Those stockmen who have followed the essential principles developed have withstood the depression with its low prices much better than has the average stockman. Range-research results have furnished the foundation for the range phases of the emergency conservation work. In the artificial reseeding, for example, which will restore vegetation for grazing and for erosion control on many thousands of acres, the plants which have been proved promising in the several hundred research tests will be sown on a broad scale, while unwise seeding with plants which have been proved to be unadapted to western-range conditions will be prevented. Likewise, the greatly expanded program of eradicating poisonous plants from the range by this corps will follow approved methods of eradication. Many other valuable results might be cited.

An exhaustive analysis made for the Copeland report brought out clearly the problems involved in the conservation and use of the forage resource on the 334 million acres of forest land grazed. They are evidenced by the poor condition of much of the forest-range area of the West, the extreme and continuing deterioration of forage and watershed-protective values on most public-domain forest lands and on a considerable part of the private forest lands in the West that are grazed, the damage to timber production in the South resulting from uncontrolled burning of forest lands in an effort to improve range conditions, and the deterioration of some farm woodlands as a result of heavy browsing of tree sprouts. These problems emphasize the need for considerable expansion of the range-research program.

Although hampered by reduced appropriations and a heavy load of planning and handling emergency work, good progress was made on going research projects. The value of conservative grazing in stabilizing production of cattle in the northern Great Plains area in Montana is indicated by recent studies there. Under the common range practice of the area, vegetation is so closely utilized each year that there is no reserve to offset scant production during drought, such as prevailed for 3 years up to the spring of 1932. Inadequate feed culminated in forced shipments of nearly 60 percent of the breeding herds in the area, at ruinous prices. Contrasted to this, on experimental ranges conservatively grazed, the breeding herds were fully maintained, although supplemental feeding was necessary. After the break of the drought, forage production on the experimental ranges was from 2 to 3 times as much as on outside ranges, and of far better quality. Young cows gained nearly 3 pounds per day until well into the summer of 1932.

Another result brought out in the study is that at least 30 acres of this type of range in reasonably good condition are required to support a cow through the year. Three-year-old cows with ample range forage weighed in early June, on an average, 43.9 pounds more than those that had been on heavily grazed range the previous 11 months, and their month-old calves averaged 6.7 pounds heavier. At 5 cents a pound these increased weights more than paid for the additional range used. Further, the overgrazed ranges declined in value.

Studies completed during the past winter of range conditions on the foothill and desert range of the Intermountain region clearly indicate why social and economic conditions are so unsatisfactory for the part of the industry using these ranges. In the sage brush-wheatgrass foothills, grazing capacity on most of the land has declined almost 70 percent as compared to check areas largely protected from grazing and now in good condition. Much of this decline has been in palatable grasses. In the desert-shrub types that are used for winter grazing the decline in grazing capacity has reached an average of 58 percent. White sage, which is an excellent forage, has been replaced over extensive areas by other brush and by weed species of low forage value. Less intensive checks of conditions in the winter range of eastern Utah, in the Snake River Plains of southern Idaho, and in northern and central Nevada show declines in grazing capacity of from 50 to 80 percent. The greater part of these declines have occurred in palatable perennial grasses, which have been replaced by annual plants and weeds, both of much lower value than the grasses.

Further analysis of the influences of climate and grazing upon black grama grass ranges in southern New Mexico indicate that it is possible to predict, from the rainfall of 1 year, whether in the following year there will be a greater stand available, or less. If the rainfall is above the normal, the stand of black grama will increase in the following year, and if it is below normal will decrease, regardless of the following summer's rainfall. The rainfall of each summer, however,

largely determines the height growth of black grama on the existing stand. These findings are of great importance in planning stocking and sales of livestock to offset the influence of drought—the arch enemy of profitable livestock production on semidesert ranges of the Southwest.

EXPENDITURES AND RECEIPTS

The expenditures during the fiscal year were as follows:

General administration			$263,040.68
Administration, protection, improvement, reforestation, and extension of national forests:			
Operating expenditures—			
Timber use	$457,317.77		
Grazing use	781,039.85		
Recreation and land use	283,104.35		
Fish and game protection	135,266.27		
Classification, settlement, and claims	73,644.81		
Maintenance of truck and horse trails	1,152,258.84		
Maintenance of other improvements	598,806.38		
Subtotal		$3,481,438.27	
Protection expenditures—			
Fire prevention and detection	1,554,934.47		
Fire suppression	1,016,206.80		
Class total (fire)	2,571,141.27		
Protection against insects and tree diseases	376,662.88		
Subtotal		2,947,804.15	
Investment expenditures—			
Construction of truck and horse trails	4,594,113.31		
Construction of public camp ground improvements	75,000.00		
Construction of other improevments	1,924,242.20		
Equipment and stores	2,005,218.03		
Timber surveys and plans	156,885.70		
Grazing surveys and plans	66,733.46		
Fish and game surveys and plans	16,206.98		
Recreational use surveys and plans	28,053.45		
General surveys and maps	162,736.66		
Timber stand improvement	32,734.54		
Reforestation of denuded areas	170,558.00		
Nurseries and planting stock	67,469.19		
Acquisition of land, by direct purchase	209,171.15		
Acquisition of land, by exchange	[1] 83,065.77		
Subtotal		9,592,188.44	
General planning and direction of emergency conservation work, national forest camps		417,109.18	
Construction and maintenance of forest highways:			
Construction of forest highways	$9,569,816.66		
Maintenance of forest highways	407,357.71		
Subtotal		9,977,174.37	
Total, national forests			26,415,714.41
Research—			
Forest management		571,552.84	
Range investigations		128,976.97	
Forest products		643,035.12	
Forest survey		181,474.68	
Forest economics		74,056.85	
Erosion and streamflow		96,235.64	
Forest taxation and insurance		39,935.65	
General planning and direction of emergency conservation work		6,846.13	
Forest Products Laboratory, construction		233,565.96	
Total			1,975,679.84
Protection and reforestation of other than national forest lands:			
Tree planting in cooperation with States		73,780.13	
Fire protection in cooperation with States		1,865,895.00	
Protection of Oregon and California grant lands		90,611.36	
Extension of forestry practice on State and private lands		122,023.83	
Total			2,152,310.32
General planning and direction of emergency conservation work on State, private, and erosion and flood control camps			93,706.31
Miscellaneous—			
Examination and administration of power sites for Federal Power Commission			18,619.00
Grand total			30,919,070.56

[1] In addition to the expenditure for acquisition of land by exchange, national forest timber having an estimated value of $238,868 was cut under agreements involving the acquisition of land and timber through exchange, The cash expenditures recorded opposite "Acquisition of land, by exchange" cover merely the outlay incidental to examining lands offered for exchange and appraising the value involved.

The following statement shows the gross and net cash receipts from the national forests:

Gross receipts:		
From the use of timber	$782,808.33	
From the use of forage	1,498,208.82	
From special land uses, water power, and miscellaneous receipts	345,031.99	
Total		$2,626,049.14
Amounts paid to States:		
To Arizona and New Mexico (account school lands administered by the Forest Service)	28,456.35	
To States in which national forests are located (act of May 23, 1908)	650,860.74	
Total to States		679,317.09
Net total receipts to United States Treasury		1,946,732.05

The total of the gross receipts is greater by $331,801.81 than that for the previous year. Receipts from timber decreased $266,299.23, grazing receipts increased $668,248.70, and miscellaneous receipts decreased $70,147.66.

In addition to the cash receipts from timber there should be credited the value of the timber cut under specific agreements for effecting land exchanges, estimated at $238,868.

U.S. GOVERNMENT PRINTING OFFICE: 1933

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ANNUAL REPORT OF THE CHIEF OF THE GRAIN FUTURES ADMINISTRATION, 1933

UNITED STATES DEPARTMENT OF AGRICULTURE,
GRAIN FUTURES ADMINISTRATION,
Washington, D.C., September 1, 1933.

SIR: I submit herewith a report of the work of the Grain Futures Administration for the fiscal year ended June 30, 1933.

Respectfully,

J. W. T. DUVEL, *Chief.*

Hon. HENRY A. WALLACE,
Secretary of Agriculture.

The work of the Grain Futures Administration during the year dealt primarily with the supervision of trading in grain futures on the 12 grain exchanges, designated as contract markets by the Secretary of Agriculture under the Grain Futures Act, upon which future trading was conducted during the year.

The aggregate volume of trading in grain futures on the Nation's grain-futures markets during the fiscal year totaled 14,247,204,000 bushels, an increase of 5 percent, as compared with the preceding year's volume of 13,566,157,000 bushels, and a decrease of 30 percent from the 10-year (July 1, 1922–June 30, 1932) average annual volume of 20,297,973,000 bushels. Trading in wheat futures amounted to 10,890,295,000 bushels, 76 percent of the aggregate volume of future trading in all grains. This was a slight increase from the preceding fiscal year during which the aggregate volume of trading in wheat futures amounted to 10,147,490,000 bushels. Trading in corn futures totaled 2,424,850,000 bushels, as compared with 2,638,849,000 bushels during the preceding year. This is the smallest annual volume during the 12 fiscal years that records have been compiled by the Grain Futures Administration. The aggregate volume of trading in oats futures during the year amounted to 570,839,000 bushels, an increase of 49 percent above the record low volume of 382,149,000 bushels recorded during the preceding year. The volume of trading in rye futures, 256,170,000 bushels, was 25 percent less than the 342,369,000-bushel volume during the preceding year, and the lowest annual volume since records have been kept by the Administration. Transactions in barley futures amounted to 79,016,000 bushels, an increase of 152 percent from the 31,317,000-bushel volume recorded during the preceding fiscal year. The volume of trading in flax futures aggregated 26,034,000 bushels, a slight increase over the preceding year, when the total was 23,983,000 bushels.

On 3 of the 15 exchanges that have been licensed as futures markets, namely, the Baltimore Chamber of Commerce (inactive as a futures market since 1924), the New York Produce Exchange, and the Grain Trade Association of the San Francisco Chamber of Commerce, there was no trading whatever in grain futures during the year. Future trading on the Omaha Grain Exchange was suspended by its board of directors on December 7, 1932.

The largest daily volume of trading on the Chicago Board of Trade during the past year was recorded on June 26, 1933, when sales of all grain futures totaled 208,516,000 bushels. A few weeks later, on July 20, 1933, a new record volume for the 12-year period during which the Administration has compiled records was established when the day's sales of grain futures on the Chicago Board of Trade aggregated 269,413,000 bushels. The previous record volume for 1 day was 256,529,000 bushels on March 13, 1925. Sales of wheat futures alone on July 20 aggregated 163,099,000 bushels, as compared with the previous record daily volume of 156,126,000 bushels established on October 24, 1929. The aggregate

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volume of trading in all grain futures on the Chicago Board of Trade during the past fiscal year was 12,124,894,000 bushels, an increase of 4 percent as compared with the aggregate volume of 11,619,942,000 bushels for the preceding fiscal year.

The aggregate annual volume of trading in wheat, corn, oats, rye, barley, and flax futures on each contract market upon which future trading was conducted during the year, and on all markets combined, is shown in table 1. The average, maximum, and minimum daily volume of trading in each grain future, and all futures combined, on the Chicago Board of Trade during the past year, with the respective dates, is shown in table 2. The monthly volume of trading in wheat and corn futures, respectively, on each contract market where these futures were traded in, is shown in tables 3 and 4.

TABLE 1.—*Total volume of trading in wheat, corn, oats, rye, barley, flax, and all grain futures combined on the contract markets, fiscal year ended June 30, 1933*

[In thousands of bushels, i.e., 000 omitted]

Market	Wheat	Corn	Oats	Rye	Barley	Flax	All grains
Chicago Board of Trade	9,093,048	2,295,054	510,249	204,606	[1] 21,937	-------	12,124,894
Chicago Open Board of Trade	267,470	41,358	1,245	64	-------	-------	310,137
Minneapolis Chamber of Commerce	588,893	-------	56,105	41,429	56,573	12,643	755,643
Kansas City Board of Trade	798,586	78,356	-------	-------	-------	-------	876,942
Duluth Board of Trade	102,188	-------	-------	7,728	-------	13,391	123,307
St. Louis Merchants Exchange	10,828	25	-------	-------	-------	-------	10,853
Milwaukee Grain and Stock Exchange	19,351	9,898	3,240	2,343	446	-------	35,278
Seattle Grain Exchange	5,449	-------	-------	-------	-------	-------	5,449
Portland Grain Exchange	3,071	-------	-------	-------	-------	-------	3,071
Omaha Grain Exchange [2]	-------	159	-------	-------	-------	-------	159
Los Angeles Grain Exchange	-------	-------	-------	-------	60	-------	60
Hutchinson Board of Trade Association	1,411	-------	-------	-------	-------	-------	1,411
Total	10,890,295	2,424,850	570,839	256,170	79,016	26,034	14,247,204
Percent of total trading done on Chicago Board of Trade	83.5	94.6	89.4	79.9	27.8	-------	85.1

[1] Trading in barley futures on the Chicago Board of Trade, which was discontinued Sept. 19, 1923, was resumed Nov. 10, 1932.

[2] Trading in grain futures on the Omaha Grain Exchange was suspended by its board of directors, Dec. 7, 1932.

TABLE 2.—*Average, maximum, and minimum daily volume of trading in grain futures on the Chicago Board of Trade during the fiscal year ended June 30, 1933, with dates of largest and smallest day's trading in each grain future*

[In thousands of bushels, i.e., 000 omitted]

Grain	Average daily volume of trading	Largest volume of trading in single day		Smallest volume of trading in single day	
		Bushels	Date	Bushels	Date
Wheat	31,355	131,506	June 27, 1933	4,004	Dec. 24, 1932
Corn	7,914	48,362	June 26, 1933	887	Feb. 2, 1933
Oats	1,759	22,069	-----do-------	65	Feb. 11, 1933
Rye	706	6,871	-----do-------	0	Feb. 20, 1933
Barley [1]	121	1,180	June 27, 1933	0	([2])
All grains	41,810	208,516	June 26, 1933	5,700	Dec. 24, 1932

[1] Trading in barley futures, which was discontinued Sept. 19, 1923, was resumed Nov. 10, 1932.

[2] Frequently.

TABLE 3.—*Wheat: Monthly volume of trading in wheat futures on each of the contract markets during the fiscal year ended June 30, 1933*

[In thousands of bushels; i.e., 000 omitted]

Market	1932					
	July	August	September	October	November	December
Chicago Board of Trade	482,360	1,018,240	693,301	579,038	582,848	400,588
Chicago Open Board of Trade	17,846	27,286	20,202	20,637	19,155	17,433
Minneapolis Chamber of Commerce	29,852	66,269	52,647	43,771	47,862	31,074
Kansas City Board of Trade	56,441	81,888	49,934	59,335	59,673	31,989
Duluth Board of Trade	2,832	15,941	11,752	8,578	12,179	4,937
St. Louis Merchants Exchange	597	1,042	828	743	863	483
Milwaukee Grain and Stock Exchange	833	1,528	1,305	1,019	1,060	828
Seattle Grain Exchange	413	809	418	296	661	227
Portland Grain Exchange	118	435	105	99	318	87
Hutchinson Board of Trade Association	352	310	50	122	244	101

Market	1933					
	January	February	March	April	May	June
Chicago Board of Trade	433,192	288,482	456,266	1,309,623	1,276,645	1,572,465
Chicago Open Board of Trade	19,458	13,275	15,099	31,202	31,904	33,973
Minneapolis Chamber of Commerce	29,207	23,170	27,766	80,088	63,733	93,454
Kansas City Board of Trade	28,792	36,569	45,467	110,672	95,505	142,321
Duluth Board of Trade	5,954	2,244	4,318	9,815	9,534	14,104
St. Louis Merchants Exchange	617	330	481	1,797	1,612	1,435
Milwaukee Grain and Stock Exchange	741	550	990	3,191	3,059	4,247
Seattle Grain Exchange	155	87	87	554	712	1,030
Portland Grain Exchange	46	40	89	708	554	472
Hutchinson Board of Trade Association	11	22	37	60	49	53

TABLE 4.—*Corn: Monthly volume of trading in corn futures on each of the contract markets during the fiscal year ended June 30, 1933*

[In thousands of bushels; i.e., 000 omitted]

Market	1932					
	July	August	September	October	November	December
Chicago Board of Trade	92,849	171,560	117,061	101,168	139,098	93,266
Chicago Open Board of Trade	2,292	2,974	2,492	2,377	2,283	2,489
Kansas City Board of Trade	2,693	2,787	1,798	1,934	2,989	2,814
St. Louis Merchants Exchange	25					
Milwaukee Grain and Stock Exchange	414	692	434	430	450	365
Omaha Grain Exchange [1]	10	97	32	20		

Market	1933					
	January	February	March	April	May	June
Chicago Board of Trade	69,077	47,275	80,125	272,839	515,445	595,291
Chicago Open Board of Trade	2,275	1,116	1,522	4,972	9,266	7,300
Kansas City Board of Trade	2,421	1,738	4,605	12,148	17,089	25,340
Milwaukee Grain and Stock Exchange	337	205	471	944	2,265	2,891

[1] Trading in grain futures on the Omaha Grain Exchange was suspended by its board of directors Dec. 7, 1932.

SUSPENSION OF REPORTING REQUIREMENT

The requirement that all clearing members of the several contract markets report daily to the respective field offices of the Administration regarding the individual open commitments of the large operators in the futures market was suspended by the Secretary of Agriculture on October 22, 1932, effective at the opening of the market on the following business day, October 24. These reports always have been regarded by the Administration as essential to the effective and economical enforcement of the statute. Following the suspension of the reporting requirement for an 8-month period in 1927, as an experiment, the then Secretary of Agriculture, William M. Jardine, reported to the Senate as follows:

> The decision to suspend the reporting requirements was not fully concurred in at the time by some of the responsible officers of the Grain Futures Administration, but the act of suspension is regarded now as having been a valuable experiment and as furnishing about the only means by which an important question could be settled definitely and satisfactorily for all time.—([U.S.] 70th Cong., 2d sess., S.Doc. No. 264, p. 15.)

Notwithstanding the conclusive results of the 1927 demonstration, certain grain-exchange and trade interests continued to broadcast their contention that the filing of these daily reports concerning the market position of the largest traders was "keeping buyers out of the market," though, apparently for some mysterious reason, the reporting requirement did not seem to deter those who wished to sell from entering the market. The upshot was that Secretary of Agriculture Arthur M. Hyde, on October 22, 1932, in order to test the truth of the contention that the discontinuance of the daily reports to the Grain Futures Administration would result in improved markets for producers, directed the suspension of the reporting requirement, at the same time issuing the following announcement:

> It has long been the contention of the grain exchanges and of the grain dealers that the regulation of the Grain Futures Administration requiring reports of trades in excess of 500,000 bushels by individual traders have resulted in narrowing the market and lowering the prices of grains. Grain dealers are now almost unanimous in saying that a modification of this regulation would result in larger purchasing and broader commodity markets. While there can be no absolute assurance that such modification will result in immediately higher prices there is widely held opinion that broader markets will finally result in better prices to the farmers. In view of those representations and of the fact that prices of wheat, corn, and oats are ruinously low, I am persuaded to test the truth of such views and have directed that on and after Monday, October 24, 1932, the requirement that the long and short position of individual accounts be waived. This modification is conditioned on the fact that the Chicago Board of Trade has by resolution of its board of directors undertaken to prevent harmful short selling. This modification shall remain in effect until notice of hearing on the reinstatement of the regulations shall have been given or until undue price fluctuations or price levels occur which indicate manipulation of the market.

Contrary to the apparent expectation, however, wheat prices following the suspension of the reporting requirement went down instead of up—in fact declined to levels previously unknown in American grain-futures markets, the December wheat future selling at 41½ cents on November 25, and the May wheat future selling at 43¼ cents on December 28, both quotations constituting all-time record lows for the respective futures on the Chicago Board of Trade. In fact, at no time following the suspension of the reporting requirement did the highest price reached by the May wheat future exceed the lowest price of the future on October 22 until after the bank holiday in March 1933, subsequent to which, owing to causes patently without relationship to the suspension of the reporting requirement affecting large operators, futures prices rose materially.

POSITION OF LARGE SPECULATORS

The records of the Administration disclose that the large speculative traders, nstead of remaining out of the grain futures market by reason of the reporting requirement, were operating principally on the short side of the market during the major portion of the entire period from April 1930 to October 1932. During this period comprising 769 days, the large speculators, i.e., those having individual open commitments on any one day of at least 500,000 bushels in one wheat future, taken as a group, were on the short side of the market 643 days, or 83.6 percent of the time.

The burden of the hedging sales and the short selling by the large professionals was borne in large part by the small traders comprising the "general public", who trade in small quantities and rarely have a position in the market in excess of 100,000 bushels, and who were aided during a part of the 2½-year period by the stabilization operations of the Federal Government.

During the year the Administration prepared a report to the Senate in response to Senate Resolution No. 376, Seventy-second Congress, second session, setting forth detailed information relative to the suspension of the reporting requirement. This report was published as Senate Document No. 61, Seventy-third Congress, first session.

FUTURES PRICES

A new all-time record low price for wheat futures on the Chicago Board of Trade was established on November 25, 1932, when the December wheat future sold at 41½ cents per bushel. All-time record lows for the May and July wheat futures were established on December 28, 1932, when these futures sold at 43¼ cents and 43⅜ cents, respectively. The all-time low for the Chicago September wheat future was established during the preceding fiscal year when on September 30, 1931, September wheat sold at 44⅝ cents. The all-time low of 20¾ cents for the Chicago December corn future, recorded on September 8 and 9, 1896, was reached on December 23, 1932. A new all-time low for oats futures was established on December 3, 1932, when the December future sold at 13⅞ cents. An all-time low for the May oats future was recorded on March 2 and 3, 1933, when sales of Chicago May oats were made at 15¾ cents. An all-time low for Chicago rye futures was established on November 1 and 3, 1932, when the December future sold at 26¼ cents. On the same dates the May rye future equaled its previous record low of 30¼ cents established April 8, 1897. A new low for the July rye future was reached on July 1, 1932, when sales were made at 27⅜ cents.

Following the resumption of future trading on the Chicago Board of Trade after the bank holiday, on account of which the grain futures market was closed from March 4 to March 15, inclusive, both volume of trading and prices increased materially. Records compiled by the Administration disclose that the daily volume of trading in Chicago wheat futures increased during March to an average of 26,839,000 bushels, as compared with a daily average of 13,113,000 bushels during February. The average daily volume of trading in all grain futures combined increased from a daily average of 15,639,000 bushels during February to 32,516,000 during March, and the aggregate volume of trading increased each month throughout the remainder of the fiscal year. During June, the final month of the year, the average daily volume of sales of Chicago wheat futures alone amounted to 60,479,000 bushels, sales of all grain futures averaging 95,188,000 bushels each day. Meanwhile, futures prices increased steadily. The July wheat future, which closed on March 3 at 48¾ cents, advanced 98 percent by June 27, on which date it sold at 96¾ cents, the high for the fiscal year. The July corn future, which on March 3 closed at 26⅜ cents, advanced 112 percent by June 27, when it established a high for the fiscal year by selling at 55⅞ cents.

The wide-spread participation in the grain-futures market continued into the present fiscal year, the amount of contracts open in Chicago wheat futures increasing from 164,834,000 bushels on June 30 to 199,711,000 bushels on July 19, the greatest for any July 19 during the 10 years that records have been compiled by the Administration, and practically double the 10-year (1923–32) average open commitments for the corresponding day.

JULY PRICE COLLAPSE

The extraordinary rise in futures prices following the resumption of trading after the March bank holiday was brought to a dramatic end on July 19 and 20 by what was probably the most sensational collapse in futures prices in the history of the Chicago Board of Trade. Wheat futures prices at the close on July 20 were 24⅝ to 25⅝ cents net lower as compared with the closing quotations on July 18. Corn futures were 16¼ to 17⅞ cents net lower. Oats futures showed a net decline for the 2 days of 12¾ to 14 cents. Rye futures crashed 34¼ to 38 cents, net, during the 2 days. Barley declined 10 cents, the maximum price change possible for that grain under board of trade rules, which had been invoked by the board of directors of the Chicago Board of Trade effective at the opening of the market on July 19.

The Chicago Board of Trade, by order of its directors, was closed for 2 days following the July 19–20 price debacle, with the exception of a 15-minute session on July 22 held to permit buyers of indemnities to exercise their privileges. Since the reopening of the market on July 24, daily price fluctuations have been limited by order of the board of directors, by whom absolute minimum futures prices were also imposed during the periods July 24 to 27 and August 1 to 15. Trading in privileges also was suspended by exchange action. With respect to this action a committee representing the grain exchanges recently issued the following statement:

> The elimination by the exchanges of trading in indemnities has removed one of the prime causes of excessive price movements.

REPORTING REQUIREMENT REINSTATED

The requirement that clearing members of contract markets report daily to the Grain Futures Administration concerning the open commitments of large traders, which requirement was suspended on October 22, 1932, was reinstated by order of the Secretary of Agriculture on July 20, 1933, following the price collapse of the grain-futures market. An extensive investigation has also been begun by the Administration to ascertain, so far as is possible, the factors responsible for the July price collapse.

This investigation will embrace a detailed examination of each Chicago wheat futures account between June 15 and July 31, 1933, which at any time during the period had open commitments of 200,000 bushels or more in any wheat future. A similar study is being made of Kansas City and Minneapolis wheat-futures accounts showing an open interest of 100,000 bushels or more.

OPEN COMMITMENTS

The Administration continued the announcement daily during the year of the amount of open commitments (contracts remaining unfulfilled by the delivery of grain or not closed by an offsetting purchase or sale) in each grain future on the books of clearing members of the principal contract markets. The amount of open commitments in each wheat and corn future on the Chicago Board of Trade, at semimonthly intervals, is shown in tables 5 and 6, respectively.

TABLE 5.—*Wheat: Open commitments in each wheat future on the Chicago Board of Trade, shown semimonthly for the period June 30, 1932, to June 30, 1933* [1]

[In thousands of bushels; i.e., 000 omitted]

Date	Future					
	July	September	December	March	May	All wheat futures
1932						
June 30	13,198	62,415	30,160	-------	-------	105,773
July 15	1,196	68,396	41,551	-------	-------	111,143
July 30	-------	61,636	59,447	-------	-------	121,083
Aug. 15	-------	39,500	85,005	30	14,495	139,030
Aug. 31	-------	9,790	110,145	30	36,649	156,614
Sept. 15	5	2,099	112,386	30	47,907	162,427
Sept. 30	205	-------	113,034	25	58,124	171,388
Oct. 15	2,457	-------	97,988	25	64,498	164,968
Oct. 31	5,502	-------	76,453	25	72,620	154,600
Nov. 15	12,010	-------	61,918	25	81,048	155,001
Nov. 30	26,535	-------	13,990	31	97,961	138,517
Dec. 15	32,521	-------	3,731	26	102,391	138,669
Dec. 31	33,870	10	-------	20	99,452	133,352
1933						
Jan. 14	34,128	3,746	-------	20	94,811	132,705
Jan. 31	34,648	5,572	-------	20	92,678	132,918
Feb. 15	36,741	9,728	-------	20	85,456	131,945
Feb. 28	39,797	13,062	-------	20	76,523	129,402
Mar. 15 [2]	40,502	13,769	-------	-------	73,055	127,326
Mar. 31	46,660	25,844	-------	-------	54,995	127,499
Apr. 15	59,156	47,103	-------	-------	30,214	136,473
Apr. 29	63,817	72,527	1,665	-------	10,464	148,473
May 15	60,052	79,311	9,041	-------	1,907	150,311
May 31	45,449	86,733	19,059	-------	-------	151,241
June 15	25,163	104,221	30,780	-------	-------	160,164
June 30	5,364	95,707	58,518	-------	4,760	164,349

[1] The maximum open commitments in all wheat futures was 174,752,000 bushels on Oct. 4, 1932. The minimum was 101,409,000 bushels on July 1, 1932.

[2] Owing to the bank holiday the Chicago Board of Trade was closed from Mar. 4 to Mar. 15, inclusive. The open commitments, therefore, remained unchanged from the close of the market on Mar. 3 to the opening on Mar. 16.

TABLE 6.—*Corn: Open commitments in each corn future of the Chicago Board of Trade, shown semimonthly for the period June 30, 1932, to June 30, 1933* [1]

[In thousands of bushels; i.e., 000 omitted]

Date	Future						
	July	September	December	March	May	Other	All corn futures
1932							
June 30	6,621	14,974	5,623				27,218
July 15	373	16,464	7,397				24,234
July 30		16,936	9,343				26,279
Aug. 15		14,693	13,465	10	1,414		29,582
Aug. 31		6,287	22,444	10	4,589	5	33,335
Sept. 15		336	25,236	5	6,705	5	32,287
Sept. 30			29,661	5	8,179	5	37,850
Oct. 15	385		32,795	10	12,212		45,402
Oct. 31	1,190		29,251	15	16,440		46,896
Nov. 15	3,273		23,618	20	22,809		49,720
Nov. 30	7,575		7,001	25	33,896		48,497
Dec. 15	10,032		1,403	25	37,662		49,122
Dec. 31	12,115			15	37,721		49,851
1933							
Jan. 14	12,465	815		15	38,984		52,279
Jan. 31	14,113	1,143		15	38,055		53,326
Feb. 15	14,668	1,651		15	38,138		54,472
Feb. 28	15,437	2,422			38,547		56,406
Mar. 15 [2]	15,561	2,756			37,875		56,192
Mar. 31	17,678	5,190			30,009		52,877
Apr. 15	22,606	10,196			17,171		49,973
Apr. 29	27,933	17,128	339		6,393		51,793
May 15	36,172	26,123	2,618		1,610		66,523
May 31	35,145	32,533	8,996				76,674
June 15	23,756	43,746	16,594			45	84,141
June 30	3,911	49,780	36,666		32		90,389

[1] The maximum open commitments in all corn futures was 93,423 bushels on June 28, 1933. The minimum open commitments in all corn futures was 24,060 bushels on July 1, 1932.

[2] Owing to the bank holiday the Chicago Board of Trade was closed from Mar. 4 to Mar. 15, inclusive. The open commitments, therefore, remained unchanged from the close of the market on Mar. 3 to the opening on Mar. 16.

CLASSIFICATION AND DISTRIBUTION OF FUTURES TRADERS

The Administration has completed a survey of (1) the open commitments in Chicago wheat and corn futures on June 30, and (2) transactions in Chicago wheat and corn futures on July 1, 1931. This survey involved the examination of the records of 115 clearing members of the Chicago Board of Trade, and of more than 300 nonclearing commission houses. The total number of individual customers involved was 9,525, distributed among all the States of the Union (with the exception of Nevada), the District of Columbia, Hawaii, Canada, and Europe. The number of traders in the several localities ranged from 1 each in Rhode Island and Hawaii to 2,240 in Illinois (of whom 1,087 were located in Chicago). Iowa was second with 1,585 traders in the market. Seventy-four percent of all traders in the wheat- and corn-futures market were classified as speculators. Hedgers accounted for 15 percent of the aggregate number, while the remainder was made up of pit traders or scalpers, spreaders, and traders not classified located in Europe.

The investigation disclosed that of the 3,802 traders on the long side only of the wheat-futures market, 1,784, or 47 percent, had open commitments in job lots (quantities of less than 5,000 bushels), aggregating 3,108,000 bushels. Of the 883 traders who were in the wheat market on the short side only, the open commitments of 256, or 29 percent, were in job lots aggregating 434,000 bushels. Of 3,174 speculative traders who were on the long side only of the wheat futures market, 24 percent held but 1 job lot (1,000 bushels) each, and 73 percent held not more than 5,000 bushels each. There were 10 traders whose individual open commitments in Chicago wheat futures amounted to 1,000,000 bushels or more; 4 of these large traders were on the long side of the market, their total open commitments aggregating 4,610,000 bushels, and 6 were on the short side of the

wheat market, their combined open commitments amounting to 10,710,000 bushels, equivalent to 13.6 percent of the total open commitments in Chicago wheat futures, and 3.45 times the combined holdings of the 1,784 small traders on the long side of the wheat market. The data analyzed also disclosed that the July 1 transactions of scalpers or pit traders trading for their own accounts comprised 53 percent of the total volume of trading for the entire market in wheat futures and 58 percent in corn futures.

DELIVERIES ON FUTURES CONTRACTS

While grain-futures contracts may be fulfilled by delivery of grain through the transfer of warehouse receipts covering grain in store in such warehouses as are designated regular by a contract market, ordinarily the volume of contracts so fulfilled is extremely small. During the period commencing with the 1924 September wheat future and ending with the 1933 May wheat future, the records of the Administration disclose that the volume of futures contracts in any major future (March excluded) settled by delivery of wheat did not exceed three-fourths of 1 percent of the total volume of trading in the future, and in but 1 delivery month of the 35 was a percentage this high recorded. Deliveries of corn upon futures contracts during the 35 delivery months amounted to less than 1 percent of the total futures sales, with the exception of 8 months during which the volume of futures settled by delivery ranged from 1.01 to 3.95 percent of the volume of trading in the respective futures.

The volume of trading during the life of each principal grain future on the Chicago Board of Trade expiring during the past year, the maximum open commitments therein, the amount of open commitments at the beginning of the respective delivery months, the volume of contracts fulfilled by delivery of grain, their percentage of the total sales, and the total quantity of actual grain delivered on such contracts are shown in table 7.

TABLE 7.—*Volume of trading (sales) during the life of each principal grain future on the Chicago Board of Trade expiring during the fiscal year ended June 30, 1933, maximum open commitments in each future, open commitments in each future at beginning of delivery month, futures contracts settled by delivery of grain, and total quantity of actual grain delivered*

[In thousands of bushels, i.e., 000 omitted]

Future	Volume of trading during life of future (sales)	Maximum open commitments during life of future	Open commitments at beginning of delivery month	Futures contracts settled by delivery		Total quantity actual grain delivered
				Volume	Percent of total sales	
Wheat:						
1932 July	2,034,226	60,032	13,198	13,375	0.66	4,389
1932 September	1,251,915	69,639	9,790	9,369	.75	5,076
1932 December	2,146,611	120,960	13,990	7,846	.37	2,529
1933 May	2,000,349	102,608	10,464	8,712	.44	3,790
Corn:						
1932 July	307,907	18,750	6,621	8,872	2.88	3,535
1932 September	213,069	17,094	6,287	8,407	3.95	3,835
1932 December	381,398	32,845	7,001	7,038	1.85	2,875
1933 May	399,737	39,141	6,393	4,504	1.13	3,450
Oats:						
1932 July	37,929	5,470	2,588	1,631	4.30	661
1932 September	40,625	6,772	1,963	1,241	3.05	422
1932 December	84,070	18,942	2,270	1,949	2.32	512
1933 May	83,787	19,621	3,911	928	1.11	552
Rye:						
1932 July	47,098	5,366	2,352	2,821	5.99	1,646
1932 September	30,898	4,852	1,430	1,654	5.35	773
1932 December	33,507	5,964	1,596	1,239	3.70	772
1933 May	36,835	5,730	4,258	4,171	11.32	3,959
Barley:[1]						
1932 December	85	15	5	10	11.76	5
1933 May	4,904	754	232	257	5.24	195

[1] Trading in barley futures began Nov. 10, 1932.

LITIGATION

During the past year the United States Circuit Court of Appeals for the Seventh Circuit affirmed the decision in favor of the Government rendered during the preceding year by Federal Judge Wilkerson in the injunction suit brought by Bartlett Frazier Co. of Chicago against the Secretary of Agriculture, the Grain Futures Administration's grain-exchange supervisor at Chicago, and the United States district attorney at Chicago. The plaintiff, a grain-commission corporation with membership representation on the Chicago Board of Trade, attacked the constitutionality of certain provisions of the Grain Futures Act, and sought to enjoin the enforcement of regulations of the Secretary of Agriculture requiring the filing of reports by clearing members of contract markets showing the open grain-futures commitments of large operators, and the aggregate volume of trading and aggregate open commitments of all grain-futures customers. The plaintiff also sought to prevent the examination of its books and records by agents of the Administration, as provided for in the statute.

Circuit Judge Alschuler, in delivering the unanimous opinion of the circuit court of appeals, said in part (65 F. (2d) 350):

> The contention that through the reports and inspections appellants' business secrets and customers are more likely to disclosure, with the consequent tendency to injure appellants, cannot prevail against the paramount public interest requiring this control for the efficient exercise of which the disclosures through reports and right of inspection are quite indispensable. The statute (sec. 8) forbids the revealing by the Secretary and his assistants of individual trades and of customers; and the findings here, predicated on the evidence, show that in the decade of experience since the act became operative no instances appear where any such confidence has been violated, or where appellants, or any other traders on the Board, have suffered from any such cause. No such official misconduct appears from the evidence to have been threatened or to be imminent.
>
> * * * The suggestion that inspection of the books would cause disturbance among appellants' employees, and that certain of the required reports would incur considerable expense in their preparation, are too trivial to merit serious consideration when weighed against the wise public policy manifested by the act. * * *
>
> * * * The public interest with which this business is impressed, and the evils at which the legislation is directed, well justify the statutory provisions for inspection and reports without first requiring a hearing in each case, and a finding that there has been such conduct as gives reasonable ground for making the inspection or requiring the reports.

The plaintiff has appealed to the Supreme Court from the decision of the circuit court of appeals.

The appeal of the Chicago Board of Trade from the order of the commission created by the Grain Futures Act (the Secretary of Agriculture, chairman; the Attorney General; and the Secretary of Commerce) in the Farmers National Grain Corporation case, was argued before the United States Circuit Court of Appeals for the Seventh Circuit during the year just ended. No decision has as yet been announced by the court.

This litigation arose from a complaint filed with the Commission in 1932 by the Farmers National Grain Corporation. The complainant alleged that it, a cooperative association, was being denied membership in the Chicago Board of Trade Clearing Corporation, which denial, it was contended, was a violation of section 5(e) of the Grain Futures Act. The provisions cited require that a board of trade designated by the Secretary of Agriculture as a contract market must grant membership therein, and all privileges thereon, to the "representative of any lawfully formed and conducted cooperative association of producers," provided that such association (1) has adequate financial responsibility, (2) is engaged in the cash-grain business, and (3) has complied, and agrees to comply, with such terms and conditions as lawfully may be imposed upon other board of trade members. The Commission held that the complainant was entitled to the privilege of membership in the clearing corporation, that the denial thereof was in violation of the statute, and ordered the contract-market designation of the Chicago Board of Trade suspended for a 60-day period, reserving the right to mitigate this penalty should the board recede from its position with respect to the cooperative association. The appeal of the board of trade to the appellate court served to suspend the order of the commission.

RESEARCH PROJECTS

The more important research projects of the Administration during the year included a study of the relationship of the daily volume of trading in Chicago wheat futures to the daily price range of the dominant wheat future. For the 9 years studied it was found that there was a close relationship, that, in general, when the daily volume of future trading was small the daily price range of the dominant future was likewise small, the price range increasing with the volume

of trading. The degree of relationship found is indicated by a correlation coefficient of +0.7969 (a perfect direct correlation being represented by +1.0, anything above 0.5 tending to be of importance). Among the several projects pending at the close of the year were a study of scalping and other in-and-out trading in Chicago wheat futures, and a study of spreading between futures and of intermarket operations in wheat futures.

PUBLICATIONS

During the year Statistical Bulletin No. 41, Wheat Futures: Volume of Trading, Open Commitments, and Prices from January 2, 1930, to December 31, 1932, was prepared and sent to the printer. The detailed statistical data for the 3-year period presented in the bulletin are supplemented by summary tables covering the preceding 9 years. A similar bulletin dealing with corn futures (Statistical Bulletin No. 43) was also completed during the year, and is now in the hands of the printer. In addition to the report to the Senate (Senate Document 61, Seventy-third Congress) relative to the suspension of the reporting requirement prepared in response to a Senate resolution, previously referred to, an unnumbered mimeographed report by H. S. Irwin, entitled "Grain Trade Statistics of Great Britain: A Guide to Sources," was also issued during the year. A mimeographed publication entitled "Trade in Grain Futures", containing data relative to volume of trading and open commitments in grain futures at the principal United States markets, and futures prices at domestic and foreign markets, was issued monthly by the Administration.

U.S. GOVERNMENT PRINTING OFFICE: 1933

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REPORT OF THE CHIEF OF THE BUREAU OF HOME ECONOMICS, 1933

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF HOME ECONOMICS,
Washington, D.C., August 31, 1933.

SIR: I present herewith the report of the Bureau of Home Economics for the fiscal year ended June 30, 1933.

LOUISE STANLEY, *Chief.*

Hon. HENRY A. WALLACE,
Secretary of Agriculture.

During the past year the demands for help in the direction of emergency feeding, in food preservation, and in the renovation, making, and purchase of clothing have been greater than at any other time. These calls came not only from agencies administering relief budgets but also from home makers needing help in stretching reduced incomes to meet the needs of the family.

Many relief agencies reported as above their reach the adequate diets at minimum cost which we outlined first in 1930 for use in drought-stricken areas and then later adapted to meet the unemployment situation. As the funds of these agencies became more limited, their need became greater. They asked for help in planning diets that would give the fullest possible return in nutritive value for a small, oftentimes a pitiably small, amount of money. Not from choice, but to meet an emergency, we worked out restricted diets. In publishing these family food budgets we made clear that they were for emergency use only and that they give "irreducible amounts" of protective and other foods below which no diet should ever fall. They may not be adequate for use for a long period of time. We therefore urged relief agencies and individuals to make every effort to return as soon as possible to a diet which provides an ample margin of safety.

As a contribution to the program of adjusting agricultural production to the Nation's social and economic needs, we have completed plans for four typical diets at four levels of cost. In working these out our concern was to provide the essentials for human nutrition, and to point the way toward a balanced agricultural program—two important elements in permanent social progress.

In the textile field, the recently completed study of cotton fabrics woven from three grades of fibers contributes a type of information also needed in adjusting production to consumer needs. Quality standards are an essential part of commodity codes. To be reliable, such standards should be based on actual wearing tests. This study

of cotton fabrics and a similar one under way on wool are designed to yield such facts.

As already implied, our basic research program has been adapted where necessary to emergency needs. In general, however, it has been possible to carry along the main program with shifts in emphasis. The report of specific accomplishments follows:

FOODS AND NUTRITION

FOOD COMPOSITION

As the result of a study of all available data on the mineral content of foods, new lists of foods rich in calcium and phosphorus have been issued. Also information on the fiber content of fruits and vegetables, the composition and nutritive value of soybeans and soybean products, and the composition of milk and milk products has been summarized.

NUTRITION STUDIES

VITAMIN D IN EGGS

The study on the relation between the source of vitamin D in the diet of the hen and the vitamin D content of the egg, carried on in cooperation with the Bureau of Animal Industry, was completed. The results raised a question as to whether the large amount of oil in the diets containing 2 and 4 percent of cod-liver oil might not have had a depressing effect on the utilization of the vitamin D. To answer this question, another series of diets was planned similar to the ones used before, with the exception that all the diets contained the same amount of oil either in the form of cod-liver oil or corn oil. As a part of this study, data are being obtained on the influence of cod-liver oil on the calcium and phosphorus content of the egg.

VITAMINS B AND G IN CEREAL PRODUCTS

The results of the study on the vitamin B and G content of wheat, wheat germ, rice polishings, and yeast were summarized and published. The vitamin B (B_1) and vitamin G (B_2) values, respectively, expressed in terms of Sherman units were as follows: Yeast, 11 and 17; wheat germ, 7 and 3; wheat, 1.5 and 1; rice polishings, 6 and 1; and cottonseed flour, 5 and 2.

A paper giving the results of a study on the behavior of rats of different ages on a vitamin G-deficient diet will soon be published.

GREEN AND WHITE LETTUCE

Several years ago a study was made of the vitamin A, B (complex), and C content of the inner and outer leaves of head lettuce. Before these studies were completed, however, two other investigators made reports on the vitamin A content of head lettuce, and vitamin B was shown to be not a single entity but made up of two separate factors now known as vitamin B or B_1, and vitamin G or B_2. As a consequence, the results of the work here were not published. Recently some importance has been attached to green leaves as a source of vitamin G, and for this reason tests have been made to determine both the vitamin B (B_1) and the vitamin G (B_2) con-

tent of the inner and outer leaves of head lettuce. The results indicate that the vitamin B content of the bleached leaves is about twice that of the green leaves, but that the green leaves are about three times as rich in vitamin G as the bleached leaves.

THE YELLOW POTATO

Further work has been done in determining the vitamin A content of a yellow-fleshed potato. The potato tested was a cross between a yellow-fleshed potato obtained in Costa Rica and a white potato. The potato from Costa Rica was small, similar in appearance and texture to a white potato, but had very yellow flesh. The seedling from the cross had pale yellow flesh and was of fair size. Tests showed that it contained very small but detectable amounts of vitamin A.

QUANTITATIVE VITAMIN VALUES

During the last few years a great deal of information on the vitamin content of various foodstuffs has appeared in the literature. Many requests for information of this kind are received. It was considered advisable to bring this material together, and as far as possible to express these values quantitatively. Most of the data used in deriving the values are from studies completed before the Permanent Commission on Biological Standardization of the League of Nations adopted the international vitamin units. Since the units described by Sherman are used extensively, they have been selected for expressing the values for vitamins A, B, C, and G. All available references are being reviewed in order to obtain values for all foods on which any data are given, from which values can be estimated, if not derived directly. Curves of reference for each of the vitamins have been worked out from data obtained in the nutrition laboratory and these are used in making many of the estimates. These data will be published in the revision of Vitamins in Food Materials, first issued in 1929 in cooperation with the Office of Experiment Stations.

MINERAL STUDIES

In connection with the study of the influence of production factors on the composition of eggs, a summary has been prepared on the mineral content of eggs. A study of the rare minerals has been planned, using a Littrow-type spectrograph to identify the presence of certain elements determined only with difficulty by the usual methods.

Recently special interest has been directed to the toxicity of plants grown on soil containing selenium. The suggestion was made that small amounts of selenium in the diet might be beneficial. This is known to be true in the case of boron and some other elements. It was decided to test this hypothesis by feeding a grain known to contain minute amounts of selenium. This grain is being fed to rats as 2.5, 5, 10, 20, 40, and 58 percent of a well-balanced diet. The results obtained to date do not indicate that any beneficial effects are derived from the use of this grain in small amounts. Beginning at the level of 10 percent there is a very definite depression of the growth curve. Reproduction was also affected unfavorably by the higher percentages.

FOOD UTILIZATION

The activities in food utilization were continued along three lines, namely, research in food preparation, cooking quality and palatability of foods in relation to production factors, and preservation of food by household methods. A summary of the results follows:

COOKING FATS

Six commercial lards, two hydrogenated lards, and a hydrogenated cottonseed oil have been studied, in cooperation with the Bureau of Animal Industry, for flavor and creaming volume. Intensity and desirability of flavor of the fats was judged in hot biscuits, cold pastries, and as melted fat alone. The preliminary results show that there is a very small spread in the intensity and desirability of the flavor of the fats when used in pastry. The differences in desirability of flavor were more pronounced. The hydrogenated cottonseed oil and one of the hydrogenated lards were significantly less desirable than the other fats. The fats with the least flavor were not always considered the most desirable.

Creaming volumes were determined on the nine fats at temperatures of 18°, 21.5°, and 25° C. The creaming volume of the fats ranged from 0 to 60 percent over all the temperatures. There was a temperature for each fat at which its creaming volume was the highest after a definite time of beating. The ability of the fat to incorporate air seemed to depend upon the temperature at which the fat was creamed and was more directly related to its congealing point than to the melting point. The fat with the highest congealing point had the largest creaming volume.

EGG QUALITY AND PREPARATION

The cooperative study of the influence of production factors on the quality of eggs for use in food preparation has been continued. A method for the measurement of the leavening power of eggs was developed. Measurements on the yolks and whites for total solids, hydrogen-ion concentration, and carbon dioxide, and for viscosity of the fresh egg magma of a large number of standard eggs have been recorded for comparison with the figures on cake volume. For this purpose the volume, compressibility, and tensile strength of 25 lots of eggs have been studied.

MEAT QUALITY

The study of meat quality has been continued in cooperation with the Bureau of Animal Industry, Bureau of Agricultural Economics, and State experiment stations.

A study of the shrinkage and cooking time of roast lamb and mutton in relation to carcass grade and cooking temperature has been completed and awaits publication. According to the results, the shrinkage of lamb and mutton during roasting depends on the grade of the meat, the length of time ripened after slaughter, the oven temperature used, and the stage to which the meat is cooked, whether thoroughly well done at 83° C. or between medium and well done at 76°. The length of time in the oven depends on these same

factors, as well as on the weight of the roast. Most of these legs of lamb were aged 4 to 9 days, and all were cooked by methods which included searing and a slow finish. Lamb that is excessively fat is wasty because it loses so much fat during cooking. On the other hand very thin lamb that grades as Common or Cull takes a surprisingly long time to cook in proportion to weight, particularly when the oven temperature is as low as 125°. Lamb of the Choice, Good, and Medium grades cooked to the stage between medium and well done (76°) shrank on the average 14 percent and required 34 minutes per pound when the oven temperature for the finish was 125°. When the cooking was finished at 150° or 175°, the average shrinkage was 17 to 19 percent, and the time required was 21 to 25 minutes per pound. A significant finding of this study was that lamb cooked thoroughly well done (83°) shrank the same amount, between 25 and 30 percent, whether cooked for 1 hour per pound at 125°, or less than half as long at 175°. This is contrary to the general belief that a low oven temperature holds down the shrinkage in meat. It is apparent from these figures that the stage to which lamb was cooked made more difference on the shrinkage than did the oven temperature. This is a good argument for a roast meat thermometer in addition to an oven thermometer because the meat thermometer shows when the desired stage of doneness is reached and prevents overcooking and excessive shrinkage.

To clarify certain points in meat cooking technic, the constant-temperature roasting of beef ribs, leg of lamb, and loin of pork was compared with methods that include initial searing. The results show that initial searing improves the appearance of roasts and makes them cook faster. Searing does not tend to hold in the juices of roasts. On the contrary, it may cause the roasts to lose more weight, but the extra loss is mainly fat. The flavor, tenderness, and juiciness of the inside lean of a roast did not appear to be influenced by searing, although the flavor of the fat of the seared roasts was considered slightly better.

Another series of experiments, comparing constant moderate oven temperature with a combination of quick searing and a very slow finish for rare beef and medium-to-well-done lamb showed that faster cooking and higher shrinkage are associated with constant-temperature roasting. The results on cooking time and shrinkage suggest that average oven temperature has more influence on these factors than does initial searing. The appearance of meat cooked medium to well done at constant moderate temperature was satisfactory, but small cuts cooked to the rare stage were usually not browned attractively.

A further contribution was also made to the methodology of cooking meats. At the request of a standing committee of the cooperative meat investigations, the directions for roasting beef, veal, lamb, and pork were revised for use in the palatability tests on cuts from experimental animals. Illustrations were added showing how to sample the cooked-meat cuts, and the directions for the use of score cards were amplified. Another new feature is a discussion of procedure for conducting experiments in meat cookery so as to reduce variables to the minimum and make the findings comparable.

VEGETABLE AND FRUIT STUDIES

The study of potato quality has been continued in cooperation with the Bureau of Plant Industry. Seventeen seedlings were cooked and judged, of which 5 rated good, 10 fair, and 2 poor. A study of the chemical nature of the constituents in potatoes which cause blackening after cooking indicated that they are similar or related to the groups of chemical compounds characterized as the catechol type of tannins. It had been found earlier that a practical method of preventing blackening of potatoes was to cook them in slightly acidified water.

Experimental work on frying potato chips showed that satisfactory chips could be made from unpared potatoes, after the potatoes were mature enough for the skin to set. Washing the potatoes to remove excess starch was found to be necessary to prevent sticking, but soaking the slices in water before frying was not essential. A more crisp texture was obtained on prolonged soaking, but the flavor of the chips was decreased. The age of the potato affected the temperature of frying. Old potatoes gave the best chip at frying temperatures of 173 to 177° C., and new potatoes at a temperature of 165 to 168° C.

A method for frying carrot chips was developed. Because of their high sugar content, the low frying temperature of 140° to 145° C. was necessary to prevent overbrowning.

The study of the table quality of different varieties of green soybeans was continued in cooperation with the Bureau of Plant Industry. Several varieties native to Chosen (Korea) and Japan were found to have a texture and flavor that made a desirable green vegetable. Some of the soybeans required too long a cooking period to be practical for this use. Cooking tests were also run on several new rice samples.

A circular, Conserving Food Value, Flavor, and Attractiveness in Cooking Vegetables, was issued. This discusses the pros and cons of baking, steaming, boiling, and panning vegetables, gives a time table for cooking the common kinds, and includes suggestions for serving.

A study of the juice content of oranges of various sizes, but of the same grade, of California Valencia and Washington Navel and of Florida varieties, showed that 1 pound of any of the different varieties or sizes produced approximately 1 cup of juice. This information is more significant than a comparison of the juice obtained from a dozen oranges of different sizes and varieties because of seasonal and geographical differences in cost.

Three varieties of sesame seed submitted by the Arizona Agricultural Experiment Station were studied to determine ways of using them in the diet. These seeds, which are very rich in calcium, are palatable when toasted and may be used in any recipes in which nuts are called for, or in place of any of the small seeds used on hard rolls or shortbreads, in cookies or muffins, and in candy.

THICKENING BY USE OF EGGS OR STARCH

At the request of the terminology committee of the American Home Economics Association a study of equivalents of different starches and eggs for thickening was made. It was found that 21 percent solutions or equivalent weights of whole egg, egg yolk, and egg

white would give gels of similar strength, and mixtures of similar consistency. The study of the common starchy thickening agents, including potato starch, cornstarch, and hard- and soft-wheat flours, showed that they had viscosities of decreasing value in the following order: Potato flour, potato starch, cornstarch, and wheat flours. Mixtures of the same concentration prepared from different lots of the same starches and different brands of cornstarch varied in viscosity. It was found that while potato flour and potato starch had a greater viscosity than cornstarch, they required a more concentrated suspension to form a gel of the same strength. The wheat flour also required a more concentrated suspension to form a gel of the same strength as cornstarch.

FOOD PRESERVATION

Food-preservation studies included canning, jelly making, and drying of vegetables. Bacteriologic and organoleptic examinations for spoilage of the pork and chicken canned in 1931 were completed. The time and temperature tables for processing these foods derived from these observations are being further checked by thermocouple studies to show heat penetration of canned beef and pork and bacteriological study of containers of pork after inoculating with heat-resistant bacteria, processing, and storage.

Measurements on the major jelly juices and jellies made from them were continued through the third season. Study of the data on juices of two seasons shows variations in specific gravity, viscosity, and acidity. The variations were reflected in the quality of jelly.

Many States recognized the value of community canning centers in their relief program and asked advice on equipment and methods of handling and processing the different fruits and vegetables. In cooperation with the Extension Service and the Bureau of Agricultural Engineering, a circular entitled "Community Canning Centers" was prepared. Step by step it emphasizes the important points in the planning and successful operation of such an enterprise. Where canning is done on a large scale by amateurs, trained supervision and strict adherence to methods known to insure thorough sterilization of the canned foods is necessary not only to prevent loss of food but to safeguard the health of the people who use the canned products. For 8 years this Bureau has advocated the processing of all nonacid vegetables only under steam pressure at temperatures higher than are obtainable in the boiling-water bath. Repeated experiments in the research laboratories here and elsewhere back this up. Also the reports that come from community canning centers and the thousands of individuals who have turned to home canning in the economic crisis furnish additional proof of the soundness of this recommendation.

ECONOMIC STUDIES

FAMILY BUDGETS AND PURCHASING

The work of the Economics Division during the past year has been mainly directed toward meeting the demand for practical material on family budgets and purchasing. Requests for such material have continued to pour in from home makers themselves, and from relief

agencies, extension workers, and others concerned with helping families to make the most of their limited resources.

The need for assistance in planning food expenditures has been especially great, and further publications on low-cost diets have been added to those issued during preceding years. One of these is an 8-page folder on Family Food Budgets for the Use of Relief Agencies, giving the quantities of different foods needed weekly by families of various size to provide an adequate diet at minimum cost and a restricted emergency diet for use when funds are too low to make fully adequate nutrition possible. This folder was prepared in cooperation with the Children's Bureau of the Department of Labor to supplement the pamphlet issued jointly last year on Emergency Food Relief and Child Health. Several reports have also been prepared on dietary adjustments in the present economic emergency, for presentation to groups of public health officials, relief workers, and home economists.

In addition to this popular material on low-cost diets, a more technical publication has been prepared on Diets at Four Levels of Nutritive Content and Cost. This is now in press. The four diets presented include a liberal diet, a moderate-cost adequate diet, a minimum-cost adequate diet, and a restricted diet for emergency use. Each is shown in terms of the quantities of foods or groups of foods required yearly on a per capita basis for the population of the United States, and in terms of quantities needed yearly by individuals of different ages and degrees of activity. Quantities needed yearly and weekly by families of typical compositions are also included.

The liberal diet represents a fully adequate food supply. It is made up of items from different food groups in such quantities and proportions as to promote better-than-average nutrition. Both the minimum- and moderate-cost adequate diets provide enough of the different nutrients to cover average requirements for maintenance and growth, and to furnish a fair margin of safety. The restricted diet for emergency use provides approximately the minimum requirements of the body for the various nutrients and allows but little margin for safety. The general use of either of the two diets at the highest levels of nutritive content would undoubtedly improve the health and efficiency of the population. At the same time, it would foster the type of agriculture which represents wise utilization of land for the country as a whole.

Both the nutritive values and costs of the four suggested diets may be modified by the selection made among individual articles of food within each food group. Costs are also greatly affected by the quality of the foods selected. Therefore a brief summary of quality and size grades for many foods is included. Some of the other factors affecting costs are discussed briefly, including the packaging of food, the size of purchase, the seasonal variations in food prices, and the local and general price levels.

To meet the needs of extension workers and rural relief agencies, a summary was made of the ways in which farm families are adjusting their expenditures and their home-production programs to meet the depression. As part of the Outlook Conference for 1933, a summary was also prepared of the available facts relating

to the outlook for farm family living, covering the family income, the retail prices of the goods the family buys, and the adjustments indicated in family expenditures and in home production. This report was prepared by a joint committee representing this Bureau, the Bureau of Agricultural Economics, and the Extension Service, and was published in the Agricultural Outlook for 1933.

Material has also been brought together on suggested budgets for city families of limited means. This information has been made available to various public and private agencies interested in family budgets and in wage adjustments, and has served as a basis for answering hundreds of individual requests.

STANDARDS OF LIVING

The investigation of farm-family living in the southern Appalachian highlands, which is part of a larger cooperative study of social and economic conditions in that area, has been continued. The data from the studies of 228 families in Knott County, Ky., and 331 families in Grayson County, Va., have been summarized in graphic form and will appear as part of a joint report prepared by the Bureau of Agricultural Economics, the Forest Service, the Office of Education of the Department of the Interior, and the agricultural experiment stations of four Southern States. Information on living conditions in the southern Appalachian area from the 1930 census and from other sources has also been presented in this graphic summary.

The results of these studies of mountain families show the very low incomes which prevail in this area, and the importance of opportunities for industrial employment to supplement the income from the farm. The total expenditures for family living averaged only $450 for the Kentucky group in 1929–30 and only $399 for the Virginia group a year later. To this meager living was added the food, fuel, and other supplies furnished by the farm, which approximately equaled the cash expenses in money value.

FOOD-CONSUMPTION TRENDS

As part of the southern Appalachian highlands study, an analysis was made of the nutritive value, adequacy, and cost of the diets of the mountain families in Knott County, Ky. Some of the results of this study are presented in the section on family living, of the graphic summary of social and economic conditions.

An analysis has also been undertaken of the nutritive value and cost of the diets of three groups of wage-earning families in France, England, and Wales, from data collected by Horace Davis as part of an investigation of family living in those countries. The results of this analysis will afford an interesting contrast with the information on food consumption now being secured from dietary studies of wage-earning families in the United States.

Work has been proceeding, within the limits of the staff available, on a summary of the adequacy of American diets and of food-consumption trends as shown by the various dietary studies of rural and urban families made in this country. Work has also been continued on the nutritive value, cost, and suitability of children's diets

in the home and in institutions. A preliminary report has been issued on a special study of the food habits of preschool children, made in cooperation with mothers who are members of an honorary educational society.

TEXTILES AND CLOTHING

CLOTHING IN RELIEF PROGRAMS

The procurement of adequate clothing became a serious problem in many families during the past year. This brought numerous requests to the Bureau for information regarding clothing relief programs, economic buying, and the care and renovation of clothing. Considerable attention was therefore given to supplying material on this subject.

Relief sewing involving thousands of garments was done by rural women under the supervision of the Extension Service and by various women's organizations. In cooperation with the American Red Cross, the Bureau formulated suggestions for increased economies and efficiency in this work. A circular was issued giving instructions for equipping and conducting community workrooms. Certain types of clothing which could be made satisfactorily and economically by volunteer help were recommended after a careful study of all aspects of the problem. This circular is now used throughout the country by relief agencies and other groups assisting with such work. Other circulars discuss the planning of expenditures when the income is reduced, quality standards as a guide to buying, and the reconditioning of used garments.

Many farm families have also been attempting to make use of unsalable raw materials on hand and augment the family income by various types of handicrafts. To meet demands for information on these subjects, the Bureau has prepared instructions for the scouring and carding of raw wool at home and making it into batts for bedding. Lists of books and sources of supplies have been compiled dealing with handicrafts such as hand weaving and rug making.

COTTON-FABRICS STUDY

The comparative study of the value of different cottons in consumer use was continued. An intelligent production program must be based on the usefulness of the product to the ultimate consumer. At the present time no one knows the relative durability and relative desirability, from other standpoints, of different grades and varieties of cotton fibers when woven into fabrics. No information is available on the effect of conditions of growth of cotton on the wearing qualities of the finished goods. The Bureau is the first research organization to attempt a systematic study of this problem of great economic importance. Such information is fundamental to effective planning of cotton production in this country, and it is unfortunate that these facts are not available in the present emergency.

As a beginning, a technical bulletin is now in press reporting a cooperative study with the Bureau of Agricultural Economics on cottons selected to represent three grades of American upland cotton.

These cottons were made into standard types of sheetings because of the comparative simplicity of this construction and the possibility of giving the fabrics controlled and uniform use in an experiment of this kind. The sheets were placed in actual service during a period of 3 years and were tested at various intervals during their wear life for breaking strength, bursting strength, weight per square yard, fluidity in cuprammonium solution, copper number, and methylene-blue absorption.

In the case of all three of the cottons all the physical and chemical tests showed a progressive deterioration with service. They also showed that initially the Good Middling and Middling cottons were of the same order, but that the Strict Good Ordinary was weaker and that at the end of 200 launderings it was slightly more deteriorated than were the others after 225. A statistical study of the life and time of first break ranked the Middling above the Good Middling and the latter above the Strict Good Ordinary.

The copper number and the methylene-blue-absorption values indicated that for the major portion of its wear life the cellulose of the Strict Good Ordinary cotton was less degraded than was that of the other two cottons. The type of oxidized cellulose characterized by greatly increased methylene-blue absorption was formed as a result of wear and laundering.

There was no increased wear on the middle fold of the sheets and there were no changes due to storage for 3½ years. The appreciable differences in deterioration of the various sections of the sheets indicate that the wear alone is significant in determining the life of such textiles, contrary to the opinion of some investigators who have reported that laundering and not wear is chiefly responsible for deterioration of sheetings.

In a second portion of this study the three sheetings made from cottons selected to represent three grades of American upland cotton were desized by the enzymic method and submitted to controlled ironing conditions with a household ironer of the roll type. Similar changes were obtained at the high ironing temperatures for all three sheetings, which had been in sliding contact with the heated metallic surface for approximately 2½ seconds. The oxidation product in each case was characterized by low methylene-blue absorption and increased copper numbers.

An investigation of the wearing qualities of sheetings made from nonirrigated, irrigated, and a mixture of these cottons is also in progress in cooperation with the Bureau of Agricultural Economics. These have been put into use in a Washington hotel, and physical and chemical tests are being made on samples removed at intervals.

COTTON-FABRIC FINISHING

A technical paper, Stiffness in Fabrics Produced by Different Starches and Starch Mixtures, was published. This reports the effects on the stiffness of a sized cotton fabric produced by varying concentrations of starch pastes, by additions of borax and fat to the pastes, and by changes in humidity.

The pliability of fabrics stiffened with various starches, such as potato, canna, corn, wheat, rice, and dasheen, is now being in-

vestigated. This is done by measurements made on films prepared from typical starch pastes. Since the tensile strength, elongation, and folding endurance are all determining factors in this property of pliability, such measurements are being made. Potato starch film has been found to have the greatest tensile strength, with canna, rice, dasheen, corn, and wheat following in the order named. The results on thickness of films and in a general way the elongation were also in this order. An instrument for measuring the folding endurance of starch films has been devised, and these determinations are now in progress.

WOOL-FABRICS STUDIES

In cooperation with the Bureau of Animal Industry, a study of the relative merits of different kinds of new and reworked wool when woven into fabrics is being made with fibers produced over a period of years by controlled breeding and feeding experiments. This is an effort to determine the comparative value of these fibers from the standpoint of their ultimate use. It is also a part of a study of the influence of various animal-husbandry practices on the manufacturing properties of wool.

These wools were made into blankets under carefully controlled conditions. Blankets were chosen because their construction and use can be regulated experimentally. They were placed in service in the wards of a United States veterans' hospital 2 years ago and will be used there until no longer serviceable. Samples are removed and the deterioration tested at regular intervals. These blankets are subjected both to wear and laundering. Another series has been washed at a commercial laundry 50 times without wear. Those tested to date show a high shrinkage accompanied by increase in thickness and weight per square yard and decrease in air permeability.

Nitrogen determinations on blankets which had been laundered until too weak to continue in service and which had lost appreciable weight showed that the total nitrogen content had been maintained. A rapid dilution modification of the Kjeldahl method of determining nitrogen in this material had been developed. This new method is also applicable to silk and similar proteins. Gradual progressive damage in the scales of the wool fiber occurred with repeated washings, as measured by the Pauly diazotization test. The increase in this value was small, however, as compared with the decrease in tensile strength.

KARAKUL INVESTIGATIONS

As part of the study on karakul-sheep production which is being carried on cooperatively with the Bureaus of Animal Industry and Biological Survey, this Bureau has investigated methods of determining the gloss of the skins. This is one of their most important properties from the standpoint of market value. An instrument recently developed by A. H. Pfund, of Johns Hopkins University, has been found applicable to this work, and measurements have been made on skins produced under different animal-husbandry practices. The instrument also has possibilities as a means of determining the amount of curl on karakul skins, a second property of value in the market. This subject is now under investigation.

LINEN STUDY

A preliminary study of the serviceability of one type of hotel table damask has been completed. This was undertaken in order to obtain preliminary data on the relation of some of the construction features of these fabrics to their wearing qualities. Such information is needed both by institutional and household buyers. The linen, a single damask, was no longer serviceable after being used 2 years. In that period it had been laundered 200 times. The majority of the breaks were due to failure of the filling yarns. There was considerable variation in the length of service of individual pieces. The first break in the napkins occurred in a range of 58 to 197 launderings, the average being 128. The tablecloths ranged from 86 to 181 launderings for the first repair, with an average of 120. Most of the breaks occurred in the border sections, and the most significant type of wear occurred in lines parallel to the selvages and the hems.

INFORMATION SERVICES

The four exhibits installed at the Century of Progress Exposition in Chicago are an outstanding feature of the information work for the year. The booth in the Federal Building depicts the services this Bureau renders to the home in planning the family budget, explaining the principles of a well-balanced diet that safeguards health, arranging kitchen equipment into a labor-saving sequence, and providing quality standards for the selection of household textiles and clothing. In the Dairy Industry Building our exhibit deals with the important place of milk and dairy products in the family diet. It shows the kinds and quantities of foods to select when food money is plentiful and when an adequate diet must be provided at minimum cost. The application of scientific research to the cooking of meat is the underlying idea of the third exhibit, installed in the Agriculture Building in cooperation with the meat industry. A display of 18 wax models of cooked cuts of beef, pork, and lamb are a feature attracting large crowds. A second series of six wax models of beef rib roasts illustrates the effect of different oven temperatures on the appearance of the whole roast, the loss in drippings, and the way the meat looks at the center of the roast when carved. A series of 50 colored lantern slides showing the principles of cooking meat according to the cut is also included. The fourth exhibit is in the Social Science Building. It contrasts the home of a hundred years ago with the home of today and points out the value of home economics research and teaching in adjusting to new conditions.

The radio and the press, as well as articles in scientific and trade journals and bulletins in the regular series, were again the means of giving the public full benefit of the research in home economics. The weekly press release entitled "The Market Basket" continued to furnish newspapers and relief agencies with timely suggestions on low-cost food. Menus and recipes showed how to use inexpensive "protective" foods, that is foods rich in vitamins, minerals, and other essentials to good nutrition. Reliable methods of home canning and preserving foods were also given wide publicity. In short, the information services were keyed as far as possible to the economic situation.

U.S. GOVERNMENT PRINTING OFFICE: 1933

REPORT OF THE DIRECTOR OF INFORMATION, 1933

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF INFORMATION,
Washington, D.C., August 31, 1933.

SIR: I present herewith a report on the information work of the Department for the fiscal year ended June 30, 1933.

M. S. EISENHOWER,
Director of Information.

Hon. HENRY A. WALLACE,
Secretary of Agriculture.

NEW POLICIES AND ACTIVITIES

The national policy for American farming established by the Agricultural Adjustment Act has changed the emphasis of much of the information work of the Department of Agriculture.

In previous years the principal function of the information staff has been to interpret and place in the hands of those who can apply them, the facts and recommendations arising from the scientific, economic, regulatory, and conservation work of the Department. Information, like the basic work of the Department itself, has applied to a hundred different fronts, with varying degrees of emphasis; sometimes the information has been of primary interest to manufacturers, and at other times to farmers, to transporters, or to consumers. Although the Department's information program has been far-flung and on diversified subjects, it has not lacked a central purpose. In research, for example, the effort has been to help American farmers lower production costs, widen markets, reduce wastes in distribution, discover new uses for farm products and byproducts, adjust production on individual farms, improve the quality of farm products, and raise family-living standards.

The Department's new program does not supplant the other work; in fact, the Department's technical knowledge has become of increased importance to farmers and others. At the same time greatest emphasis now is placed on economic and social adjustments which have a single purpose—increasing the buying power of farm commodities. The production-control phase of the new adjustment program depends greatly on the voluntary cooperation of producers. This means that the Department must use every available means to acquaint farmers with facts about current supply-and-demand maladjustments, prices, and possible remedies, and about the basic principles and powers of the Agricultural Adjustment Act, because only with all the facts at their command can farmers intelligently shape a program designed to improve their economic condition, and, acting in unison, use the centralizing power of the Federal Government under the Agricultural Adjustment Act to make that program work.

FEDERAL-STATE COORDINATION

Even before the Agricultural Adjustment Act was passed, the Department was laying the groundwork for an intensive, Nation-wide program of education in economic planning.

Machinery for handling information was reorganized in a number of ways. Previously, the press work of the Department and of the State extension services was carried on more or less independently. During the early part of May

arrangements were made to clear some of the Department's press material exclusively through the agricultural extension editors in the 48 States. The Federal-State set-up makes it possible to keep the extension editors in daily touch with the Department and provides them with material which they localize for the use of more than 10,000 newspapers.

Seventeen State extension services were already cooperating with the Department in correlating agricultural radio programs; this number was quickly increased to 41, thus providing an effective Federal-State channel for the daily distribution of adjustment information.

In Washington, D.C., closer contacts were established between the Extension Service and the Office of Information. The Director of Extension Work designated Reuben Brigham, in charge of extension information, as liaison officer between the Department's Office of Information and the State extension services. Mr. Brigham arranged for the preparation of economic charts, lantern slides, and other visual material which could be used by county agents in explaining to farmers the necessity for adjustments in crop and livestock production. His staff was augmented by three field information specialists, who help State extension editors to arrange their local work to supplement more effectively what is sent out from Washington, and to bring to Washington suggestions as to informational material needed in the States.

EMERGENCY ASSISTANCE

Louis H. Bean, senior agricultural economist of the Bureau of Agricultural Economics, and later economic adviser to officials of the Agricultural Adjustment Administration, advised the radio and press writers regarding the necessary economic information that could be obtained from a multitude of sources, guided them in the preparation of addresses and articles, and critically reviewed their copy. This was essential because previously the writers in the Office of Information had depended on subject-matter specialists for all basic information and for final approval of copy as to accuracy and policy. For the new purpose, however, there was no single source or definite unit of the Department from which the necessary information could be obtained; it came from production divisions, statistical divisions, farm-management specialists, and a host of other offices and officials. The writers had to correlate these data, interpret them so that they would be understood by readers and listeners, and issue them in a way that would lead to a complete understanding of the program for farm adjustment.

The staff of the Office of Information had been curtailed during the fiscal years 1932 and 1933, and it was obvious that additional assistance would be needed. Consequently, as a temporary expedient pending the formation of an information division within the Agricultural Adjustment Administration, the Office of Information engaged the services of writers who were especially qualified to prepare interpretative information on specific commodities. E. R. McIntyre, editor of the Wisconsin Farmer and Agriculturist, was assigned to dairying and dairy products; Paul A. Porter, editor of the Lagrange (Ga.) Daily News, to cotton; Arthur T. Thompson, formerly on the staff of Wallaces' Farmer and Iowa Homestead, to corn and hogs; and Russell Lord, contributing editor of Country Home, to the preparation of bulletins and general interpretative articles. In addition, R. L. Webster, of the Press Service, was specifically assigned to handle all material on wheat, and Vernon E. Bundy, of the Division of Publications, to the preparation of material for State extension and farm-paper editors. John R. Fleming, special agricultural writer, and Arthur P. Chew, assistant to the Director of Information, prepared special interpretative and policy articles.

This staff was on hand, working under the new arrangements outlined above, when the Agricultural Adjustment Act was signed on May 12. With the passage of the act, most of the Department's regular radio programs were temporarily discontinued so that the radio staff, along with the new men, could devote full time to the single project of economic education.

REACHING FARMERS WITH ECONOMIC INFORMATION

There was naturally a brief lapse between the passage of the act and the formation of an organization adequate to put the new national policy into effect. During this period, the Department concentrated its radio and press efforts on three principal things: (1) Interpretations of various provisions of

the act—its objective, possible methods of making production adjustments, the flexible powers conferred upon the Secretary of Agriculture, the voluntary nature of farmer participation, possibilities of benefits through trade agreements, consumer protection, and so on; (2) interpretations of current economic facts, such as the loss of foreign markets, the effect on agriculture of this country's change from a debtor to a creditor status, the consequences of unbalanced production, surpluses, and low farm-purchasing power, why surpluses cause urban unemployment, and related topics; and (3) specific commodity problems, under which classification an effort was made to show to the farmers most concerned and also to other groups the consequences of specific maladjustments.

These radio and press releases, clearing for the most part through the State extension services, gave field workers and farmers first-hand information which they could study in preparing programs for submission to the Agricultural Adjustment Administration. The Federal-State information was daily supplemented by national broadcasts by the Secretary of Agriculture and other principal officials. In this way the entire Nation was made aware of the problems up for solution, the power of the Government to help, and the direction that policies were taking each day.

INFORMATION DIVISION OF THE AGRICULTURAL ADJUSTMENT ADMINISTRATION

The Agricultural Adjustment Administration speedily perfected its own organization. It established as one of its major units a Division of Information and Publicity. Alfred D. Stedman, Washington correspondent for the St. Paul Pioneer Press, was placed in charge of this Division, and Messrs. McIntyre, Lord, Thompson, Bundy, Webster, and Porter were transferred to it. That organization was expanded somewhat as time went on. Mr. Stedman became the approving officer for all information issued by the Agricultural Adjustment Administration. The Office of Information, working closely with Mr. Stedman's division, continued its network and syndicate radio services, as well as the dissemination of information through State extension editors, farm papers, and trade publications.

PRESENT PROCEDURE

This is the cooperative arrangement at the present time. How it is functioning may best be shown by a specific example.

It soon became evident that the first adjustment program would be in the Cotton Belt. While growers were conferring with the Administration on a specific program, the Department doubled its educational work in the South. By articles and daily syndicate radio programs cleared through the Southern extension editors, services to daily newspapers, and network broadcasts, the cotton farmers were acquainted with facts indicating what caused the present enormous carry-over of cotton, what would happen if another large crop were produced, the necessity of adjusting supply to demand, the power of growers to determine how much cotton is produced in the long run, the status of American cotton in the world markets, probable future demand, etc. These facts, accompanied by direct contacts by county agents, made it possible for the individual cotton farmer to decide for himself whether or not he would cooperate in a national program of readjustment.

When the program suggested to the Agricultural Adjustment Administration by cotton interests was adopted and put into effect, the provisions of this plan were explained in detail. Programs were carried each noon in the National Farm and Home Hour and in the Western Farm and Home Hour. Through the cooperation of the National Broadcasting Co. and the Columbia Broadcasting System, it became possible for the officials managing the cotton campaign to discuss each evening during a period of 2 weeks the outstanding points and problems to be considered by farmers. Extension editors localized the Department's press stories and syndicate radio programs, so as to emphasize county problems. They also arranged for local leaders to appear on local radio programs. The details of the contracts, options, what could be done with retired acreage, the probable benefit payments, how payments were to be made, the system of local administration, the farmers' point of contact in joining the plan, and related items were all explained in press stories and radio talks. The fact that nearly 1,000,000 farmers understood the program and participated in it—all within a period of 4 weeks—is evidence that they obtained accurate information.

The cotton informational campaign is typical of similar work being done with respect to wheat, corn, hogs, dairying, tobacco, fruits and vegetables, and other products.

I have reviewed this procedure in some detail in this report because it represents the largest single, intensive effort ever made by the Department of Agriculture to unify the thinking and actions of farmers.

SUPPLEMENTING INFORMATION ON ADJUSTMENTS

Of course the Department of Agriculture has for years been disseminating valuable economic information. Now, however, with a positive national policy in economical planning and adjustment, much of the economic and other technical information of the Department of Agriculture can be directed toward specific actions that should be taken. And in the educational work under way, the entire Department has been called on to supply facts that would be helpful in the adjustment program.

Toward the close of the fiscal year 1933 the Office of Information gave increased attention to coordinating the information on emergency-adjustment programs with information from the Department as a whole. The emergency programs may eventually lead to a national program of proper land use, and so it becomes necessary for the Department to give to the public all the information which it has accumulated on this subject. Farmers want information on replacement crops, soil-building crops, subsistence farming, quality production, herd improvement, farm management, market prospects, and similar subjects which they can use to advantage when they make adjustments under the emergency programs. If a national dairy program, for example, calls for a reduced volume of production, farmers will need a great variety of facts which have been developed over a period of years by the Bureau of Dairy Industry.

APPROPRIATIONS AND SAVINGS

During the closing weeks of the fiscal year 1933, the Office of Information was notified that its expenditures for the succeeding fiscal year could not exceed $916,966, as compared with an appropriation of $1,226,287. It was therefore necessary to curtail the force and to map plans for a still further reduction in the Department's printing and binding work.

On June 30, 15 employees were separated from the service. During the year the Office of Information had refrained from filling 13 vacancies, so that, in all, 28 positions were discontinued. These reductions, coupled with the 15-percent reduction in salaries, brought the estimated expenditures for salaries and expenses to $298,000, as compared with $352,847 in 1933 and with $417,207 in 1932. The plans for printing and binding will reduce expenditures for new work to $618,966 during 1934, as compared with $660,834 in 1933 and $987,000 in 1932.

In other words, between 1932 and 1934 there has been a 37-percent reduction in the printing and binding fund, and a 29-percent reduction in the fund for salaries and expenses.

All of the policies to effect economies which I outlined in my report last year were continued during the fiscal year 1933.

DIVISION OF PUBLICATIONS

While press releases and radio programs are effective in initiating action and in accomplishing a united effort on the part of millions of farmers over widely scattered areas, farmers will later need information in more detail and in more permanent form for their study and guidance if they are to carry forward intelligently the general line of march now mapped by the Agricultural Adjustment Administration. Accordingly, toward the close of the fiscal year 1933 the Division of Publications began a study of information which will likely be needed by farmers who are making readjustments in their methods of production.

Farmers are entering a new epoch of agricultural planning. They are going to need more economic information in printed form which they can use for their individual study and as a basis for determining group actions. It would seem wise to liberalize somewhat the distribution of publications to enable the public to obtain them more readily when their use will result in a better

understanding of the new agricultural program and in furthering the plans for improving the economic status of agriculture. An example of what is needed is the special publication, Economic Trends Affecting Agriculture, issued during June 1933 and distributed mainly to county agents.

ECONOMIES

Economics were effected in all phases of the work of the Division. Drastic reductions in the funds available for printing and binding, for the purchase of blank paper, and for the payment of personnel necessitated adjustments all along the line.

Steps were taken at the end of the previous fiscal year, and at the beginning of the fiscal year 1933, to reduce the number of bulletins available for free distribution, and to reduce the cost of printing administrative, technical, and regulatory publications. A full account of these actions may be found in last year's report. Manuscripts were edited with the utmost care, and only such tabular matter and illustrations as seemed indispensable were retained. Color work in publications was reduced to the minimum, and no color plates were used in the Journal of Agricultural Research. Economical make-up and arrangement for printing were given special consideration. The inhibitions against the use of mailing lists either for the sending of publications unsolicited or for the announcement of free publications remained in effect throughout the year. Such announcements as were made by the Department referred only to the availability of publications by purchase from the Superintendent of Documents.

To assist his office and to make it more convenient for visitors to purchase Department publications, a branch office of the Superintendent of Documents was established in the Division.

After eliminating more than 130 bulletins from the free list, the size of the editions of those retained was curtailed. A limitation of 500 copies of any farmers' bulletin or leaflet was placed upon individual orders from Members of Congress, while State extension directors were limited to 50 copies on each order, and county agricultural agents to 25 copies. Later in the year the limitation was raised to 100 copies for the State directors, and to 50 for county agents. The general public could at first obtain only 5 publications on request, but this number was later raised to 10.

By arrangement with the Superintendent of Documents, separates from the Journal of Agricultural Research were made available by purchase at 5 cents each if the orders were received in advance of printing. Previously these separates had been distributed free to all those applying for them before they were printed, announcements of each forthcoming separate having been freely distributed. Only 250 copies of the Journal separates were given originating bureaus and stations to provide for their official needs. The free edition of the Journal for libraries, departments, laboratories, and institutions was reduced from 2,000 to 1,780.

Foreign mailing lists were curtailed, subdivided, and classified with resulting economies in distribution to those in other countries on an exchange basis. The mailing list for the Monthly List of Publications was reduced from 31,000 to 10,000. Furthermore, that publication was issued bimonthly instead of monthly.

DISTRIBUTION OF PUBLICATIONS

Because of the numerous restrictions, the total distribution of Department publications was reduced to 14,818,459 from 25,990,752 the previous year—a reduction of about 43 percent. Members of Congress distributed only 5,634,845 farmers' bulletins and leaflets, as compared with 9,560,880 the previous year, and they generously returned to the credit of the Department 2,186,600 copies from their quotas of these publications.

Letters received in the Distribution Section, including those from Members of Congress, totaled 868,420, as compared with 1,521,905 in 1932. The Addressing, Duplicating, and Mailing Section issued 38,722,329 pages of multigraphed, mimeographed, and rotaprinted work, as compared with 65,579,614 pages the previous year. The items of drafting and photographic work in the Section of Illustrations totaled 117,808, as compared with 154,157 in 1932. The Joint Committee on Printing reduced from $7,500 to $3,800 the amount that could be expended for field printing.

In spite of the restrictions placed on the free distribution of the Department's publications, the Superintendent of Documents sold only 371,285 copies, exclusive of periodicals. The total sales of all series amounted to $44,144.59, of which $13,240.91 was for periodicals. This represents a decrease from the sales of the previous year.

One hundred and eighty-five manuscripts were on hand at the beginning of the year, 1,629 were sent to the printer, and 113 were on hand at the end of the year. More than 6,000 visitors to the Department received 32,619 copies of publications. The number sent to foreign countries totaled 169,950. Distribution statistics by classes of publications are given in table 1.

LIMITATION ON CASH WITHDRAWALS

In recent years changing fiscal and budgetary policies have caused serious confusion in the Department's printing and binding work. In 1932 the Office of Information was permitted to obligate and pay for printing and binding work to the extent of $987,000. Under the usual arrangement, the Office was allowed a period of 3 years to liquidate the 1932 obligations, although such liquidations have usually been completed within 6 to 8 months after the close of a fiscal year. In 1933 the Economy Act limited printing and binding obligations to $665,000, and it was assumed that these obligations could be liquidated during the usual period. However, on June 20, 1933, the Office was notified that its 1934 cash withdrawals from the Treasury could not exceed $618,966. This was an entirely new method of control. A cash-withdrawal limitation naturally applies to all checks cashed during the year, whether they are drawn on the 1932, 1933, or 1934 appropriations. As the printing work is of such nature that it takes several weeks or months to turn out the final product, particularly in the case of maps and color work, and as the Government Printing Office near the close of the year 1933 was jammed to capacity with emergency work for new Federal units, about $200,000 of the Department's work sent to the printer during 1933 was not paid for and therefore became a liability against the $618,966 cash-withdrawal limitation. After considering all aspects of the matter, the Secretary's Office allowed an offset fund to take care of this abnormal situation. Regardless of the system of control adopted, it should be kept uniform. Only in this way can the Office of Information manage the printing work for the Department so as to achieve the greatest possible economies consistent with the needs of the various bureaus.

The requirements for economy made the bureaus of the Department cautious in the early part of the year about the amount of work that they could send to the printer. During the first quarter only 16.1 percent of the total allotment was obligated; during the second quarter, 18.6 percent was obligated; during the third quarter, 29.9 percent; and during the fourth quarter, 35.4 percent. A more equitable flow of work through the Division throughout the year is desirable.

PERSONNEL REDUCTIONS AND SPECIAL WORK

During the year 22 members of the staff ceased their connections with the Division. As only 3 replacements were effected, the net result was a loss of 19 positions. This heavy loss from the staff of the Division resulted in the necessity for much overtime work on the part of the remainder of the staff and for some adjustment in the personnel of the sections. The Addressing, Duplicating, and Mailing Section assisted materially in the work of the Agricultural Adjustment Administration and from May 2 to June 30 issued 1,372,840 multigraphed, mimeographed, or rotaprinted pages for that organization. From March 1 to June 30, 1933, the personnel in that section worked more than 2,000 hours overtime. The Printing Section also helped the Agricultural Adjustment Administration in preparing the emergency forms for the printer and in expediting delivery. The new Style Manual of the Government Printing Office was issued in March 1933. In its preparation Frank D. Smith represented the Department of Agriculture and was assisted by some members of the Division of Publications, particularly in word forms and in the preparation of the index to the Manual. The comprehensive index to the Department publications for the period 1901–25 was issued during the year, as was also the complete list of Department publications for 1926–30.

TABLE 1.—*Summary of publications received and distributed by the Office of Information, Department of Agriculture, from July 1, 1932, to June 30, 1933*

Item	Copies on hand July 1, 1932	Copies of new publications received	Copies of reprints or revisions received	Total copies available for distribution during year	Copies distributed during year	Copies on hand June 30, 1933
Agricultural Situation		153,350		153,350	153,350	
Annual reports	5,823	48,797		54,620	43,799	10,821
Circulars	471,386	152,350	22,000	645,736	230,315	415,421
Climatological Data		5,220		5,220	5,220	
Climatological Data (section summary)		164,000		164,000	164,000	
Clip Sheet		340,200		340,200	340,200	
Crops and Markets		1,834,700		1,834,700	1,834,700	
Department bulletins	279,490		3,000	282,490	83,914	198,576
Department circulars	152,060		2,500	154,560	49,746	104,814
Experiment station bulletins and reports	3,056	15,600		18,656	14,027	4,629
Experiment Station Record	21,486	87,100		108,586	108,586	
Extension Service Review		51,000		51,000	51,000	
Farmers' bulletins	7,177,328	282,500	7,586,176	15,046,004	7,368,048	7,677,956
Farmers' bulletin lists	943,075		2,700,000	3,643,075	2,761,775	881,300
Forest Service recreation folders	94,285	143,000		237,285	145,825	91,460
Forest Worker		6,000		6,000	6,000	
Indexes	19,676	42,480		62,156	49,370	12,786
Inventories of seeds and plants imported		6,000		6,000	6,000	
Journal of Agricultural Research	25,478	45,800		71,278	51,746	19,532
Journal of Agricultural Research separates	266,228	59,850		326,078	85,448	240,630
Leaflets	986,797	105,000	878,000	1,969,797	866,854	1,102,943
Miscellaneous circulars	220,917		14,500	235,417	48,618	186,799
Miscellaneous publications	540,544	128,100	100,000	768,644	384,350	384,294
Monthly List of Publications		112,000		112,000	112,000	
Monthly Weather Review		18,000		18,000	18,000	
Monthly Weather Review separates		12,850		12,850	12,850	
North American Fauna	2,379			2,379	855	1,524
Official Record		802,300		802,300	802,300	
Posters	233,187	17,500	39,204	289,891	90,919	198,972
Public Roads	21,686	44,300		65,986	65,986	
Service and Regulatory Announcements	102,015	486,600	80,500	669,115	560,775	108,340
Soil Surveys	259,879	32,950		292,829	288,841	3,988
Statistical bulletins	43,984	6,000		49,984	14,688	35,296
Technical bulletins	358,526	121,500	4,500	484,526	203,688	280,838
Unnumbered publications	352,343	150,900	160,600	663,843	271,958	391,885
Weekly Weather and Crop Report and Snow and Ice Bulletin		264,000		264,000	264,000	
Yearbooks	7,370	15,000		22,370	11,445	10,925
Yearbook separates	179,556	53,400	9,850	242,806	121,038	121,768
Total	12,768,554	5,808,347	11,600,830	30,177,731	17,692,234	12,485,497

PRESS SERVICE

In addition to carrying on its function of giving to the press information on the results of research and other work of all the bureaus and offices of the Department, the Press Service became the distributing agency for releases issued by the Agricultural Adjustment Administration.

During May and June the Press Service furnished all papers, especially the farm papers and county-seat weeklies, with interpretative articles on the commodities most likely to be immediately affected by the program for agricultural adjustment. However, with its staff drastically reduced by the economy program, the Press Service found it difficult to cover the ordinary activities of the Department adequately, and manifestly impossible to cover the new emergency activities.

This difficulty was solved first by engaging emergency assistance and later by the Agricultural Adjustment Administration establishing its own Division of Information. However, to keep costs at a minimum and to prevent duplication in machinery, the facilities of the Press Service are being utilized. Thus the highly classified mailing lists which have been built up over a period of many years by the Press Service are being used to distribute adjustment information directly to those who are interested in the particular subject covered by each release.

TECHNICAL AND ADJUSTMENT INFORMATION

The attention of the Nation is naturally focused on emergency activities. The daily contacts of the press with the Department are greater now than during any former period. At the same time the interest of farmers and others in the Department's fundamental research and in the valuable facts it develops has increased rather than decreased. If farmers are to benefit fully from the help they may obtain from the Department, they need to cooperate in the programs for balancing supply with demand and at the same time improve their practices and reduce costs of production in accordance with the findings of science.

Accordingly the Press Service has helped correspondents obtain from all the bureaus and offices information essential to a complete understanding of the new national agricultural policy. For example, the Bureau of Agricultural Economics has furnished information on world production, consumption, and prices of wheat, cotton, tobacco, and other commodities; it has also furnished facts needed by the press for a more thorough understanding of price relationships of wheat and bread, cotton and textiles. Similarly, when the national program to curtail cotton production got under way, the technical cotton work of the Bureau of Plant Industry became of great interest to editors and to the public. There is, in fact, a definite need of integrating the production and economic information of all the bureaus with farmers' plans for physical adjustments. The Press Service is giving attention to this problem.

FEDERAL-STATE PRESS WORK

The arrangements completed during the year for correlating Federal and State press releases is one that will unquestionably prove permanently beneficial. Research, extension, and even regulatory work have long been correlated on a Federal-State basis, but press information has been carried on as an independent function by most of the agricultural institutions. The correlated system is working efficiently in accomplishing a rapid, widespread dissemination of emergency information. It will be continued in the future for distribution within the several States of information arising from the research, regulatory, conservation, and extension programs.

FOOD AND DRUG BILL

The submission of a revised food and drug bill to Congress by the Department of Agriculture resulted in a steady stream of inquiries being received by the Press Service from editors, broadcasters, and advertising agencies. Among other things, the new bill would prohibit false and misleading statements in food, drug, and cosmetic advertising. Viewed from the standpoint of the Department's responsibility to consumers, this would be a most desirable extension of Federal regulation. At present, products must be labeled truthfully, but collateral forms of advertising often mislead the public. The result is detrimental to the health of millions of consumers and is inimical to the best interests of honest manufacturers and producers. The new bill would place upon the manufacturers of foods, drugs, and cosmetics the responsibility of making all advertising conform to standards of truth. The Press Service has endeavored to answer inquiries on this one phase of the new bill and has referred to the Food and Drug Administration inquiries regarding other provisions.

SPECIAL SERVICES

With millions unemployed and others with greatly reduced incomes, one of the principal functions of the Press Service continued to be the dissemination of information on adequate diets at minimum cost. The Market Basket, prepared by the Bureau of Home Economics, has been issued weekly since January 1931. Editors of hundreds of newspapers asked that they be given this information regularly and reported that it was of value to relief agencies and to individuals in maintaining health.

Information developed by the Department is given primarily to those who can make best use of it. A typical example of this was the use made by the Press Service of an interpretive article on the recent discovery that the development of rancidity in oil-bearing foods may be greatly retarded by placing such foods in grass-green containers. This article was sent to journals covering

the following fields: Flour milling, dairy products, peanuts, feedstuffs, baking, spices, confectionery, packaging, paper making, soaps, and perfumes. It was used by practically all of the trade publications, and many of them wrote in for additional information on the same subject. In this way the results of valuable research were placed quickly in the hands of those who process, ship, or otherwise handle oil-bearing foods, the annual trade of which amounts to much more than one billion dollars.

One of the most important outlets for agricultural information is the national feature syndicates. During the early part of the fiscal year the N.E.A. Service (750 papers) carried a series of vegetable and flower garden articles by W. A. Taylor and W. R. Beattie, of the Bureau of Plant Industry. This series followed closely on the heels of a series of commodity-price charts prepared especially for N.E.A. by the Bureau of Agricultural Economics. This same syndicate used another group of articles under the head, "Uncle Sam's Tips on Vegetable Gardening." The Associated Press Feature Service (1,250 member papers) which has run regular series from the Department in previous years, last spring published a garden series by L. C. Corbett, of the Bureau of Plant Industry, covering a period of 10 weeks. This and other series were designed especially to help families with little, if any, income.

The Western Newspapers Union, serving between 2,000 and 3,000 country weeklies, regularly gave wide distribution to home economics, livestock, and crop information. Its home economics sheets are made up entirely of material prepared in the Department.

During the year, 1,473 mimeographed releases were issued to the press, an increase of about 240 over the previous year. In addition, there were 93 statements from the Secretary's Office and 103 exclusive articles, including specials to press associations and syndicates. The Press Service also distributed 212 special reports issued by the Bureau of Agricultural Economics. The Official Record was discontinued, as well as the position of the editor. Other positions discontinued because of reduced funds were: Editor of the Daily Digest, general office manager, and one agricultural writer.

RADIO SERVICE

The Nation-wide system of correlated Federal-State broadcasts, proposed 2 years ago by the Chief of Radio Service, was brought to practical realization during the fiscal year 1933. In January 1932 the extension services of 18 States joined with the Department in correlating their agricultural broadcasts through individual stations in each State with the Department's broadcasts. This number dropped to 15 and then increased again to 17 by the beginning of the fiscal year 1933. Ten months later the extension services of all the States except Kentucky, Wisconsin, Illinois, Texas, Wyoming, Oregon, and Vermont had joined the correlated system.

This greatly accelerated development of a correlated system for agricultural broadcasting was due almost entirely to the immediate necessity of having a closer tie-up between Federal and State agricultural information work as a means of forwarding the program of the Agricultural Adjustment Administration. Through this system national policies of adjustment and the local application of these policies were daily brought to the attention of the radio audiences of 217 cooperating stations. Immediately after the passage of the Agricultural Adjustment Act, the programs were prepared entirely by the Radio Service and cleared through the State extension services. For the first 20 days the programs carried complete explanations of the general policy established by the act, and of the economic situation of the basic commodities. Later as the program of farmer-Government cooperation to restore purchasing power of the basic commodities took form, the State extension editors supplemented the releases from Washington with the facts concerning the application of the adjustment programs to each farm business in their States. There was considerable expansion, in this way, in the use of radio broadcasting for distributing agricultural information through individual stations. An even greater expansion took place in the use of the facilities contributed by the network companies.

NETWORK PROGRAMS

The amount of time used by the Department of Agriculture in the daily National and Western Farm and Home Hour programs broadcast by 58 associate radio stations of the National Broadcasting Co. was increased from 20 to 30 minutes. Whenever necessary the National Broadcasting Co. and asso-

ciated stations made available the complete time of these programs (1 hour for the National Farm and Home Hour; 45 minutes for the Western Farm and Home Hour). In addition, both the National Broadcasting Co. and the Columbia Broadcasting System made available evening periods for the broadcast of programs supporting the campaign to bring about a reduction in acreage of cotton for harvest this year. Each evening during the progress of this 2-week campaign, the Columbia Broadcasting System carried a 15-minute program on the southern stations affiliated with its Dixie network, and the National Broadcasting Co. and associated stations of the South carried another 15-minute program. These broadcasts, together with the Department period in the National Farm and Home Hour each noonday, kept cotton growers and campaign workers informed daily of the latest regulations, of the progress made toward the campaign goal, and of the reasons why cotton growers proposed and the Administration made effective the emergency adjustment plan. Secretary Wallace said in letters to the presidents of the National Broadcasting Co. and of the Columbia Broadcasting System that these broadcasts were of material assistance in bringing the gigantic operation to a successful conclusion.

The network companies at the close of the fiscal year had arranged to make available evening periods for broadcasts supporting the campaign to secure cooperation of wheat growers in adjusting their acreage for harvest in 1934 and 1935. In addition, both networks carried a number of broadcasts by the Secretary and the Assistant Secretary before and immediately after the Adjustment Act was passed, explaining its provisions to the general public.

At their request the Office of Information provided last-minute news of actions of the Agricultural Adjustment Administration to news commentators broadcasting through the Nation-wide networks, notably Boake Carter, Lowell Thomas, and Frederick William Wile.

LOCAL AND SYNDICATE PROGRAMS

Following suggestions from the Radio Service, State agricultural extension editors arranged a number of special programs in the evening hours for broadcast over individual stations explaining the local plans for the campaigns of acreage adjustment. A number of these programs consisted of interviews between county agents and leading farmers of the community. The Radio Service also arranged broadcasts from field meetings in the first stage of the wheat-adjustment campaign. In these broadcasts Adjustment Administration officers, who were conducting meetings for the training of extension service personnel, acquainted the general public with the preliminary plans of the campaign and the reasons for undertaking the adjustment program.

As the programs for adjustment developed and it became necessary to issue special releases on the economic position of and the plans for production adjustment and marketing agreements on more and more commodities, the Radio Service was unable to write all these special programs and maintain its former volume of general feature releases. For this reason the weekly release entitled "The Primer for Town Farmers", the biweekly releases entitled "With Uncle Sam's Naturalists", and "Chats with the Weather Man", and the monthly release, "The Agricultural Situation Review", were temporarily discontinued.

However, at the close of the fiscal year plans were being made to resume these general releases and to reorganize the Farm Flash programs so as to include both agricultural-adjustment information and technical information from other units of the Department of value to farmers cooperating in the adjustment program. The plan is to include both types of information in the Farm Flashes and in the network Farm and Home Hour programs also, just as soon as the emergency programs have been brought to a successful conclusion, and the problems of adjusting practices as well as acreages and numbers of animals come to the fore.

SPECIAL CONSUMER BROADCASTS

To reach consumers with information of special value to them, the Department accepted the invitation of the General Federation of Women's Clubs to take part in a weekly afternoon program over the network of the National Broadcasting Co. The Radio Service is cooperating with the Consumers' Counsel of the Agricultural Adjustment Administration in preparing material for these programs. The Agricultural Adjustment Act calls upon the Secretary of Agriculture to see to it that increased prices for farm products do not result in disproportionately higher prices to consumers. The most effective instrument

for preventing price gouging is publicity. The Department's programs have given to consumers facts about price relationships, such as the relationship between wheat and bread prices, and between cotton and textile prices, which they can use in judging the trend of prices in their own communities.

HOME-MAKERS' PROGRAMS

The regular Housekeepers' Chat daily programs, prepared in cooperation with the Bureau of Home Economics and broadcast by 194 individual stations, continued on the usual schedule. A start was made during the year toward improving the broadcasting technic of home demonstration agents using the Housekeepers' Chats and State material. The Radio Service and the Extension Service accepted the invitation of the New York State home demonstration leader to conduct a series of four 1-day schools for the training of New York State home demonstration agents in the preparation and delivery of home economics broadcasts designed to increase the effectiveness of home demonstration work in that State. These schools were held at Buffalo, Syracuse, Ithaca, and Schenectady for the instruction of 45 home demonstration agents.

RESULTS OF SURVEYS

The Chief of Radio Service and the extension radio specialist cooperated during the year in conducting and writing the report of a survey of radio broadcasting in the land-grant colleges and universities and the separate State universities of the Nation. The other agencies which joined in the survey were the American Association of Land-Grant Colleges and Universities, the Association of State University Presidents, the United States Office of Education, the National Committee on Education by Radio, and the National Advisory Council on Radio in Education. The survey itself and the publication of results were financed by the National Committee on Education by Radio. In general, the survey revealed a decline in the number of radio stations operated by the institutions surveyed. At the same time it showed a growth in the amount of broadcasting done by the agricultural extension services affiliated with the institutions and the Department. The agricultural broadcasting done by the institutions was edited more carefully and rehearsed more thoroughly than any other type of educational broadcasting done. In many cases the only editing of programs reported was done on the agricultural programs.

That the radio audience for Department programs is growing, and that the programs themselves are more effective was indicated during the year from many sources. Letters from listeners were more preponderantly of the type expressing appreciation of the service and requesting further information. Press comment, especially in the farm press, noted the unique service given by Department broadcasts, particularly in the interpretation of policies and actions of the Department with respect to agricultural adjustment. For example, in its issue of May 15, the Ohio Farmer commented editorially:

> No Administration has ever made the effort to keep people informed as to what it is doing as has the new Administration at Washington. * * * No department has gone to greater lengths in this respect than the Department of Agriculture. * * * The National Farm and Home Hour has proved an admirable method of bringing statements of progress and policy directly to the farm audience. * * * Both the Administration and the radio chains which make this possible are to be commended.

Letters from State extension editors expressed appreciation of the high standards of quality and effectiveness set by the Department radio releases.

A survey conducted during the year by the director of agriculture for the National Broadcasting Co. gave conclusive evidence of the wide scope of the daily audience to Department network programs. Questionnaires were sent to 3,000 master farmers. Seven hundred returned the questionnaire. Ninety percent listened to the radio at noon, and more than half listened 6 days a week. Eighty-two percent listened more than 3 days a week, and only 3 percent listened but 1 day a week. Ninety percent indicated they listened attentively to talks. One third kept notes on what was said, and more than half requested printed information as offered. Ninety-five percent found information presented by the Department helpful, and the same proportion applied the information in their farm practices. Not all of those replying could receive the Farm and Home Hour programs of the Department, but 88.6 percent listened to them—virtually all who could receive them.

U. S. GOVERNMENT PRINTING OFFICE: 1933

For sale by the Superintendent of Documents, Washington, D.C. - - - - - - Price 5 cents

REPORT OF THE LIBRARIAN, 1933

United States Department of Agriculture,
Library,
Washington, D.C., September 1, 1933.

Sir: I have the honor to submit herewith the report of the library for the fiscal year ended June 30, 1933.

Respectfully,

Claribel R. Barnett,
Librarian.

Hon. Henry A. Wallace,
Secretary of Agriculture.

For the library, the past year has been one of suspense and temporary adjustments. At the time of the moving of the library last year it was expected that the new stacks would be available within 4 or 5 months, but unfortunately they have not yet been provided. Though the stack building in the court between wings 4 and 5 has not, therefore, been used by the library, it has been used for other purposes. To make this possible a temporary door was cut into the wall on the left side, on a level with the corridor of the basement. The space was first used for assembling the Department exhibit for the Century of Progress Exposition, then as a temporary lunch room for Department employees, and since the last of the fiscal year it has been used for the emergency work of the Agricultural Adjustment Administration. Because of the delay and uncertainty from month to month as to when the stacks would be provided and the consequent necessity of making temporary arrangements for the reading rooms, workrooms, and bookshelves, it has been possible to reap only partially the benefits it was anticipated would result from having new, enlarged, and permanent quarters designed especially for library use.

As the new stacks had not been erected when the library was moved last year, it was necessary to use in the new building the old shelf equipment insofar as possible. In addition, a large amount of temporary wooden shelving was required to provide for necessary expansion, since in the old quarters in the Bieber Building the shelves were extremely crowded. Moreover, several thousand books which were previously filed in the bureaus and offices were returned for filing in the main library at the time of the moving. The number of standard 3-foot shelves occupied by the collections in the Bieber Building in May 1931, and the number occupied in September 1932, are shown in table 1. To provide room for the shelving it has been necessary to occupy temporarily 16,273.4 square feet of office space which had been intended for other offices of the Department. As this office space is on the first floor of both wings 4 and 5 of the South Building, on both sides of the corridors running from B to C Streets, it means that the book-stack space is in the shape of the letter U. To get from the end of the east side of the stacks in wing 4 to the end of the west side of the stacks in wing 5 means a walk of 2½ blocks, since there is no connecting corridor on the first floor of the C Street side. Few of the books are within a half block of the loan desk. It is conservatively estimated that the average distance which it is necessary to go from the loan desk to get a book from the stacks is an ordinary city block. It will be apparent how greatly this has hampered the service of the library during the past year.

Previous to the moving to the new quarters in the large South Building, it had been confidently expected that the library would be brought in closer contact with more of the offices making frequent use of its services, and it was hoped that this would result in increasing the reference use of it, thus making unneces-

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sary the sending of such large numbers of books by messengers to the various offices, which practice is extremely hard on the books. Although it has never been feasible to keep any record of the reference use of the library, it is estimated that this is less than 3 percent of its total use. Unfortunately, as it has turned out, there has been little if any increase in this reference use during the past year. It is still necessary to send just as many books to the offices. It is believed that this has been due very largely to the fact that the present temporary arrangement of the books makes access to them inconvenient to the readers, and to the fact that few of the offices which make most use of the library are at present located in wings 4 and 5. It is earnestly hoped that the permanent stacks will be provided within the next few months. From the library's point of view, it would also be most desirable if, when all of the seven wings of the South Building are finally completed and permanent quarters are assigned to the various offices of the Department, consideration might be given to the needs of the research units and abstracting offices which make most use of the library, with the view of locating them in as close proximity to it as possible. The possibility or impossibility of carrying out such a plan has a direct bearing on the future policy in regard to the centralization of the library's collections and in regard to the reference service.

On pages 7 to 15 are given the statistical tables which have been compiled from reports submitted by the heads of the divisions of the main library and the reports of the branch libraries in the various bureaus. These tables give a detailed synopsis of the routine work of the library insofar as the work can be expressed in statistical form. They show some increases and some decreases as compared with similar figures for previous years. A comparison of the finances for the past 10 years is given in table 15. It will be seem that the funds available for general expenses were $4,520 less than in the previous year, but in addition ot this decrease in the total amount of its appropriation, the library was this past year obliged to pay for certain operating expenses which in previous years had been borne by the Secretary's office. The largest increase in these expenses was in connection with the building maintenance. The assessment on the library for its share of this expense in the new building was $1,300. Beginning with the past year it has also been necessary for it to pay for its telephone and telegraph service, a charge formerly borne by the Secretary's office. The overhead expenses now paid for by the library, which at one time were all borne by the Secretary's office, include shop work, chare service, stationery supplies, drayage and express, trucking service, telephone and telegraph service, and building maintenance. One after the other, these items have been added to the library's fixed expenses, to be paid for from its own appropriation. The only maintenance charges which are not now paid from the library's funds are the charges for electricity and heat. In the course of years the increase in its book fund has therefore in reality been considerably less than the figures would indicate. In the past year the amount available for books and periodicals was further very considerably decreased because of the necessity of paying a large amount for the temporary wooden shelving and for the new permanent equipment.

Not only were fewer books purchased during the past year, but also the number received by gift and exchange was smaller, due no doubt to present economic conditions. The number of books, pamphlets, and continuations added was 17,696. The total number of books and pamphlets now contained in the library is 242,075. (For full particulars of accessions, see table 2.) To the many institutions, societies, officials, and publishers in this country and abroad who have been able to carry the address of the library on their mailing lists and to private individuals who have generously contributed publications to it, grateful acknowledgment is made. Among the most important of the single gifts was a beautifully illustrated book entitled "A Contribution to the Knowledge of the Avifauna of the Riu Kiu Islands", 1925, a gift from the author, Prince Nagamachi Kuroda, of Tokyo, Japan. To A. A. Schenk the library is indebted for the gift of his copy of the Nomenclature of the Apple, edition 2, 1905, by W. H. Ragan (United States Department of Agriculture, Bureau of Plant Industry Bulletin 56) which he had interleaved with manuscript annotations of new varieties. Special mention should also be made of a collection of books given to the library from the estate of the late C. F. Langworthy, formerly Chief of the Office of Home Economics of the Department. Because of the decreased amount available for the purchase of books and periodicals, few additions were made to the library's collection of old and rare books. The only accession in this class deserving of special mention was a copy of Mathieu van Noort's Pomologia Batava [1830]. One important periodical set was completed, namely, the Tijdschrift voor Veeartsenijkunde.

PERIODICALS

In spite of the decreased funds for books and periodicals, a special effort was made to continue all periodical subscriptions and to get the new periodicals needed in the work of the Department. The total number of different periodicals received by purchase, gift, and exchange was 4,319 as compared with 4,250 in 1932. The number received by purchase was 1,324, and 2,995 were received by gift. Further details in regard to the periodicals are given in table 8.

CATALOGING AND CLASSIFICATION

The number of books cataloged during the past year was less than in the previous year, on account of the decrease in funds for the purchase of books, the moving of the library, and a decreased staff. (Full details in regard to the cataloging are given in tables 3 to 7.) It was frequently necessary during the year to take the catalogers from the cataloging work to do emergency work in the reference room, at the loan desk, and in the binding section. Because of the interruption in the binding work during the moving of the library and the need for having the binding of the current material more nearly up to date, it seemed necessary to detail one of the catalogers for this work for several months. In the classifying work some progress was made in reclassifying soils and fertilizers, cereals, and horticulture, all of which were badly in need of expansion. A new edition of the library classification was also prepared and sent to the Public Printer on June 18, 1933. This will be the fourth edition of the classification. The third was issued in 1916 and is now out of print.

BINDING

As a result of the special efforts in connection with the binding work, the number of volumes sent to the Government Printing Office for the year showed an increase of 960 as compared with the previous year. This increase in the number of books permanently bound was, however, attained at the expense of a decreased number placed in temporary binders. Full details regarding the binding are given in table 9.

USE OF THE LIBRARY

The combined statistics of circulation in the main library and in the branch libraries are given in table 10, insofar as these statistics are available. They show a recorded circulation of 108,805 books and 229,435 current periodicals which is an increase of 262 books and 12,301 periodicals over the previous year. The figures indicate only approximately the use of the library, as no record of the circulation of periodicals is kept in the main library nor in the Bureau of Agricultural Economics library. Also, no record is kept of the reference use.

The total number of interlibrary loans, exclusive of photostat copies and typewritten articles, was 2,361, as compared with 2,751 in the previous year. Part of this decrease was doubtless due to the fact that out-of-town loans were discontinued during July 1932, when the library was being moved into its new quarters, the necessary assistants for attending to such loans not being available. The decrease may also have been due to some extent to the unsettled economic conditions at the State agricultural colleges and elsewhere which may have decreased the research work. Full details in regard to the interlibrary loans is given in tables 11 to 13.

BIBLIOGRAPHICAL WORK

In the series of Bibliographical Contributions issued by the main library, a second edition was issued of no. 23 entitled "Agriculture of the American Indians", by Everett E. Edwards, associate agricultural economist, Division of Statistical and Historical Research, Bureau of Agricultural Economics.

In the Bureau of Agricultural Economics library the following additions were made to the mimeographed series of Agricultural Economics Bibliographies:

No. 38. List of State Official Serial publications Containing Material on Agricultural Economics. Compiled by Esther M. Colvin. July 1932. 222 p.

No. 39. Greece: a Guide to Official Statistics of Agriculture, Population and Food Supply. Pt. I. An Annotated List of Official Publications. Compiled by A. M. Hannay. Pt. II. Methods of Collection and Analysis of official Statistics. By J. D. Black and Constantin Ladas, for the Bureau of International Research of Harvard University and Radcliffe College. Oct. 1932. 142 p.

No. 40. Barter and Scrip in the United States. Selected References. Feb. 1933. 43 p.

No. 41. The Domestic Allotment plans for the Relief of Agriculture. Selected References. Compiled by Louise O. Bercaw. Feb. 1933. 48 p.

No. 42. Measures Taken in Foreign Countries to Relieve Agricultural Indebtedness. Compiled by A. M. Hannay, May Coult, and Lillian Crans. Mar. 1933. 57 p. Supersedes a preliminary draft not for distribution or release issued in mimeographed form on Oct. 14, 1932.

No. 43. Part-time Farming. A brief List of Recent References. Compiled by Esther M. Colvin. Feb. 1933. 20 p.

No. 44. Uses for Cotton. Selected References in the English Languages. Compiled by Mildred C. Benton, Division of Cotton Marketing branch library. Nov. 1932. 43 p.

No. 45. State Measures for The Relief of Agricultural Indebtedness in the United States, 1932 and 1933. Compiled by Louise O. Bercaw, Margaret T. Olcott, and Mary F. Carpenter. Mar. 1933. 64 p. Supersedes a preliminary typewritten list issued in February or March 1933.

No. 46. Group and Chain Farming in the United States, January 1930–March 1933; With Some References to Group Farming in Foreign Countries. Compiled by Esther M. Colvin. Mar. 1933. 28 p.

The Bureau library also prepared the following unnumbered mimeographed bibliographies:

Periodicals Received Currently in the Library of the U. S. Bureau of Agricultural Economics. Compiled by Vajen E. Hitz. Dec. 1932. 195 p.

Some Books on the What and Why of Depressions. By Mary G. Lacy. Address, annual meeting, Columbia Library Association, Frederick, Md., Apr. 29, 1933. 5 p.

In the Bureau of Agricultural Engineering library, bibliographies in mimeographed form were prepared on the following subjects: Power Alcohol, 29 p.; Soil Erosion, 32 p.; and List of Publications on Agricultural Engineering, 23 p.

In the Bureau of Dairy Industry library, work was continued on the revision of Bibliographical Contribution No. 6 entitled "Partial List of Publications on Dairying Issued in the United States." The unnumbered list of available publications relating to dairying was revised twice during the year.

In the Bureau of Entomology library, work was continued on index V to the Literature of American Economic Entolomogy. Approximately 5,000 references were added during the year. The subject and author lists of publications of the bureau were also kept up to date.

In the Office of Experiment Stations library, the sixth supplement to Department Bulletin 1199, List of Bulletins of the Agricultural Experiment Stations for the Calendar Years 1931 and 1932, was compiled and is ready for printing. The indexing of the periodical articles written by State experiment station workers and published in outside journals was also continued. For the past fiscal year there appeared 1,276 such articles in approximately 50 scientific journals and proceedings of scientific societies.

In the Forest Service the work in connection with the development of camp libraries for the Civilian Conservation Corps led to a great demand for the bibliography Some Books on Forestry in English, and the supply was entirely exhausted. It is being revised and will soon be available.

In the Bureau of Plant Industry the bibliography of Plant Genetics: Cytology, Variation, Crop Breeding, to 1930, which was completed in the fiscal year 1932, was sent to the Public Printer in June. It will be issued as Miscellaneous Publication No. 164 of the Department. Work on the list of world floras was continued. This is to be a joint publication of Sidney F. Blake, of the Office of Botany, and Alice C. Atwood, of the library of the Bureau of Plant Industry. An article entitled "Historic Sketch of Tulip Mosaic or Breaking", prepared by Marjorie F. Warner, in collaboration with M. B. McKay, formerly agent of the Bureau of Plant Industry, appeared in the July issue of the National Horticultural Magazine.

The following mimeographed current literature lists were continued during the year: Agricultural Economics Literature, by the Bureau of Agricultural Economics library; Agricultural Engineering Current Literature, by the Bureau of Agricultural Engineering library; Agronomy Current Literature and Botany Current Literature, by the Bureau of Plant Industry library; Cotton Literature, by the Division of Cotton Marketing, Bureau of Agricultural Economics; Entomology Current Literature, by the Bureau of Entomology library; and Highways Current Literature, by the Bureau of Public Roads library. The bimonthly list of Forestry Current Literature was issued by the Forest Service library through October 1932, and then was temporarily discontinued on account of the death of the librarian of the Forest Service. It is planned to resume publication later.

Due to the restricted amount of mimeographing paper which could be used, it was impossible to continue Agricultural Library Notes throughout the fiscal year. It was temporarily discontinued with the June-October 1932 number, but publication will be resumed beginning with July 1933.

LEGISLATIVE WORK

Legislative reference work is one of the important activities of the libraries of the Bureaus of Agricultural Economics, Agricultural Engineering, and Public Roads. This work has been exceptionally heavy during the past fiscal year on account of the great amount of important legislation enacted. Among the bills of special interest to the Department which were closely followed as they went through Congress were the Department of Agriculture Appropriation Act, the Agricultural Adjustment Act, the National Industry Recovery Act, the Farm Credit Act, the Tennessee Valley Authority Act, the Federal Emergency Relief Act, the Forestation Unemployment Relief Act, the Securities Act, the Banking Act, the Muscle Shoals Act, the Gold Clause Repeal Act, the Independent Offices Appropriation Act, the Fourth Deficiency Act, the Economy Act, and the act providing for inspection of American-grown apples and pears for foreign markets. In the libraries of the bureaus mentioned the Congressional Record was scanned daily for items of interest, copies of the bills of interest were obtained and filed, and also copies of the hearings on them. In the Bureau of Agricultural Economics library a daily index of items of interest to the Bureau was continued during the sessions of Congress and distributed to Bureau officials. A total of 1,477 bills of interest to the Bureau were filed in the Bureau library, of which 448 were introduced in the Seventy-second Congress, first session, 558 in the Seventy-second Congress, second session, and 471 in the Seventy-third Congress, first session. In the Bureau of Agricultural Engineering library approximately 900 bills were followed during the entire Seventy-second Congress, and about 280 bills in the Seventy-third Congress, first session. The records of the Bureau of Public Roads library show that in the Seventy-second Congress, second session, there were 367 bills introduced of interest to the Bureau, and that 57 of these became laws. In the Seventy-third Congress, first session, that library followed the course of 683 bills. Of this number 132 were acted upon, and 105 became laws. Of the 105 there were 45 of special interest to the Bureau. In all, the Bureau was interested in 1,050 bills.

BUREAU AND DIVISION LIBRARIES

In table 14 will be found a list of the branch libraries in the bureaus and offices and data in regard to them. Cataloging statistics are included in tables 6 and 7. Statistics of circulation are given in table 10. Other activities are described in the body of the report under their appropriate headings.

About June 1, 1933, the Bureau of Agricultural Engineering was moved into new quarters in Temporary Building C. For its library this meant more centralization of collections, as it brought into one room those that had been spread out into two rooms and various offices. At the same time, many books and bound periodicals which were less frequently used were returned for shelving in the main library. This was necessary as the collection has been growing rapidly, and the shelves had become crowded.

The reference and bibliographical work of the past year reflected to an unusual degree the economic situation in the United States and abroad, particularly in the libraries of the Bureau of Agricultural Economics and the Bureau of Public Roads.

The interest aroused in forestry by the President's plan for developing a Civilian Conservation Corps was felt directly in the Forest Service library. Books of a general nature were sought, and that library was consulted by those developing the camp libraries. The past fiscal year also saw the preparation of A National Plan for American Forestry. This plan, prepared in response to Senate Resolution 57 (73d Cong., 1st sess., S.Doc. No. 12) covers the entire field of forestry and is both a record of past accomplishments and a program for the future. Its preparation involved the time of many members of the research organization of the Forest Service and led to what were perhaps the heaviest demands the Forest Service library has ever experienced. A heavy burden of this work fell upon Miss Stockbridge, librarian of the Forest Service, just prior to her fatal illness.

EXCHANGES

During the year 1,073 orders were issued on the Office of Publications for the mailing of Department publications, requested by foreign institutions and officials and by societies and private individuals from whom publications are received in exchange. This was a decrease of 597 as compared with the previous year. This decrease was due in part to the discontinuance of the sending of free publications to workers in institutions where the publications are available for their use in the libraries of the institutions (made necessary by the limited edition in which the Department's publications are now being issued and the consequent restriction in their free distribution), and in part to the fact that the Monthly List of Publications was issued bimonthly instead of monthly as formerly. One request for publications selected from the lists has therefore taken the place of the usual two requests.

The revision of the foreign mailing lists maintained by the Library, which was begun in June 1932, was completed, with a few exceptions, during the year.

In the report for last year mention was made of the work in progress by the librarian of the Office of Experiment Stations in checking the foreign mailing list of the Experiment Station Record in order to learn the number and value of the publications that are received by the Department in exchange for the Record. This work was completed in August 1932, and the findings were used in the compilation by the Office of Experiment Stations of a list of Agricultural Research Institutions and Library Centers in Foreign Countries, which was issued in mimeographed form on July 1, 1933.

LIBRARY STAFF

Thirty-four permanent employees were carried by the main library at the close of the fiscal year and 70 by the bureau and office libraries, making a total of 104. Of this number there were 15 in administrative positions (including the librarian of the Department, the heads of divisions in the main library, and the librarians of the bureaus), 82 library and clerical assistants, 1 translator, and 6 messengers. There were few changes during the year. Staff meetings were held in January, February, April, and June.

On December 20, 1932, Helen E. Stockbridge, who had been librarian of the Forest Service for 31 years, died after only a week's illness. Her detailed knowledge of the development of forestry, her interest and zeal in the work, and her willingness to assist all who came to her with their problems identified her intimately with the progress of forestry. Her death was a serious blow to the Forest Service, to the library, and to the profession.

TABLE 1.—*Shelves now occupied by collections filed in the main library*

Class no.		Shelves	
		1931	1932
	Reference books:		
200–243	Encyclopedias, dictionaries, directories, atlases, etc	216	239
	Miscellaneous	42	43
	Total	258	282
	General books:		
110	General periodicals	16	16
119–120	Biography	32	34
124–145	Travel, history, and miscellaneous	52	55
	Total	100	105
	Agriculture and forestry:		
1	Department of Agriculture publications	125	135
2–5	General agricultural societies	132	135
6–28	General agricultural periodicals	931	1,023
30–39	General agricultural books	96	97
40–50. 8	Animal husbandry	477	602
53–58. 9	The soil	119	125
59–79	Crops	159	179
80–98. 9	Horticulture	448	438
99–99. 9	Forestry	81	94
100	State experiment stations, United States	87	92
101–109. 5	Foreign experiment stations	85	98
	Total	2,740	3,018
	Government documents, statistics, law, and education:		
148–174	Government documents	500	499
250–273	Statistics	160	318
274–274. 99	Law	72	64
275–276	Education	148	147
	Total	880	1,028
	Economics and commerce:		
277–285	Economics	49	136
286–287	Commerce	227	370
	Total	276	506
	Engineering and manufacture:		
288–296	Engineering	190	217
297–313	Manufactures	316	391
	Total	506	608
317–324	Home economics	16	22
	Mathematics and the physical sciences:		
325–346	Mathematics and physics	95	120
381–396. 92	Chemistry and pharmacy	532	604
398–408	Geology and mineralogy	142	150
	Total	769	874
	Biological sciences:		
409–410	Natural history	230	246
411–415	Zoology	129	134
420–433	Entomology	41	49
434–439	Arachnida, etc	11	10
440	Microscopy	25	25
442	Biology and embryology	58	68
443–447	Evolution, anatomy, physiology, anthropology, and ethnology	56	65
448–449	Medicine and hygiene	379	393
450–464. 91	Botany	451	497
	Total	1,380	1,487
	General scientific periodicals and learned societies:		
470–475	General scientific periodicals	135	149
500–517	Learned societies	464	485
	Total	599	634
	Classes 1–517	7,524	8,564
	Special collections	707	893
	Total 3-foot shelves	8,231	9,457
	Shelves for folios lying flat, size 2 feet 6 inches and 3 feet	860	1,548

TABLE 2.—*Accessions, 1929 to 1933*

	1929	1930	1931	1932	1933
Purchases:					
Volumes	2,288	2,760	2,398	3,066	2,121
Pamphlets	144	180	179	233	130
Maps and charts	4	35	7	33	39
Serials and continuations	639	625	757	1,180	916
Total	3,075	3,600	3,341	4,512	3,206
Gifts:					
Volumes	1,260	1,370	1,331	1,786	2,305
Pamphlets	1,215	1,387	1,044	1,586	1,732
Maps	86	52	8	44	13
Continuations	5,992	6,739	6,281	6,414	6,236
Total	8,553	9,548	8,664	9,830	10,286
From binding periodicals and serials:					
Permanently bound	1,372	1,771	2,848	2,162	2,307
Binders	1,126	1,407	1,553	1,696	1,571
Total	2,498	3,178	4,401	3,858	3,878
New current periodicals	228	237	282	322	326
Total accessions	14,354	16,563	16,688	18,522	17,696

TABLE 3.—*Record of material cataloged, 1929 to 1933*

	1929	1930	1931	1932	1933
Volumes	3,548	4,130	3,729	4,852	4,426
Pamphlets	1,359	1,567	1,223	1,819	1,862
Maps and charts	90	87	15	77	52
Continuations and serials	6,631	7,364	7,038	7,594	7,152
Volumes received from bindery	1,372	1,771	2,848	2,162	2,307
Volumes in binders	1,126	1,407	1,553	1,696	1,571
Additions to binders	211	214	164	114	107
Current entries	228	237	282	322	326
Changed titles	77	96	68	83	64
Total	14,642	16,873	16,920	18,719	17,867
Pamphlets (author cards only)	201	206	62	320	295
Reprints (author cards only)	3,241	1,282	1,142	508	423

TABLE 4.—*Uncataloged material, 1929 to 1933*

	1929	1930	1931	1932	1933
Purchases:					
Volumes	22	40	81	216	8
Pamphlets	10	4	20	74	8
Continuations	4	7	17	21	0
Maps			14		8
Gifts:					
Volumes	677	867	1,048	1,042	761
Pamphlets	1,343	835	1,179	1,033	909
Continuations	77	380	1,352	804	314
Maps		2		2	1
Total	2,133	2,135	3,711	3,192	2,009

TABLE 5.—*Record of titles prepared for printing by Library of Congress in "Agr." series, fiscal years 1931–33*

	Prepared in—			Printed in—		
	1931	1932	1933	1931	1932	1933
Accessions and recataloged books	786	895	710	783	1,013	682
Department publications	392	418	382	303	443	410
Agricultural periodicals	150	86	83	115	145	84
Total	1,328	1,399	1,175	1,201	1,601	1,176

TABLE 6.—*Number of cards added to the dictionary catalog of the main library and to the special catalogs and indexes of the branch libraries* [1] *of the Department, 1929–33*

Library	1929	1930	1931	1932	1933
Main library, dictionary catalog	25,376	20,989	19,065	28,947	21,289
Bureau of Agricultural Economics	14,346	12,397	10,370	16,357	13,990
Division of Cotton Marketing				4,236	6,720
Bureau of Agricultural Engineering	(2)	(2)	(2)	3,431	2,169
Bureau of Animal Industry	(3)	(3)	295	11,566	3,385
Animal Husbandry Division	(3)	(3)	(3)	2,802	2,502
Bureau of Chemistry and Soils	1,346	2,248	1,893	2,718	2,300
Fertilizer and Fixed Nitrogen Investigations	(3)	(3)	(3)	500	200
Bureau of Dairy Industry	1,708	1,994	2,249	2,396	2,610
Bureau of Entomology	6,773	6,938	6,141	6,444	4,405
Division of Bee Culture	(3)	(3)	(3)	(3)	[4] 2,500
Office of Experiment Stations	5,682	7,994	5,927	5,853	6,208
Forest Service	8,000	8,500	9,000	8,000	1,807
Bureau of Home Economics	3,251	1,905	1,032	2,180	1,582
Bureau of Plant Industry	36,794	26,956	25,111	26,714	22,122
Bureau of Public Roads	16,946	21,460	18,355	25,359	20,426
Total	120,222	111,381	99,428	147,503	114,215

[1] For the most part the cards in the branch-library catalogs are analytical and index entries for articles in periodicals and are not duplicated in the dictionary catalog of the main library.
[2] Included in Public Roads.
[3] Figures not available.
[4] Estimated.

TABLE 7.—*Total number of cards contained in the dictionary catalog of the main library and the special catalogs and indexes of the branch libraries*

Library	1930	1931	1932	1933
Main library, dictionary catalog	[1] 681,000	700,055	729,002	750,291
Bureau of Agricultural Economics	105,171	115,541	131,898	145,888
Division of Cotton Marketing			7,820	14,540
Bureau of Agricultural Engineering	(2)	(2)	13,195	15,364
Bureau of Animal Industry	202,184	202,479	214,045	217,430
Animal Husbandry Division	(3)	(3)	33,198	35,700
Bureau of Chemistry and Soils	54,548	56,441	59,159	61,459
Fertilizer and Fixed Nitrogen Investigations	(3)	(3)	(3)	(3)
Bureau of Dairy Industry	30,487	32,736	35,132	37,742
Bureau of Entomology	190,096	196,237	202,681	207,086
Division of Bee Culture	(3)	(3)	[4] 75,000	77,500
Office of Experiment Stations	82,515	88,442	94,295	100,503
Forest Service	[4] 191,000	200,000	208,000	209,807
Bureau of Home Economics	16,500	17,532	19,712	21,294
Bureau of Plant Industry	550,000	575,111	601,825	623,947
Bureau of Public Roads	98,548	116,903	[5] 132,498	152,924
Total	2,202,049	2,301,477	2,557,460	2,671,475

[1] Revised estimate.
[2] Included in figures for Public Roads.
[3] Figures not available.
[4] Estimated.
[5] Exclusive of 9,764 cards transferred to Bureau of Agricultural Engineering library.

TABLE 8.—*Record of periodicals currently received, 1931 to 1933*

Item	1931	1932	1933
Different periodicals received by purchase	1,279	1,341	1,324
Different periodicals received by gift and exchange	2,904	2,909	2,995
Total	4,183	4,250	4,319
Additional copies purchased	254	243	284
Additional copies received by gift and exchange	227	254	266
Total periodicals purchased, including duplicates	1,533	1,584	1,608
Total periodicals received by gift and exchange, including duplicates	3,131	3,163	3,261
Total, including duplicates	4,664	4,747	4,869
Dailies received, including duplicates	141	114	124

TABLE 9.—*Record of binding, 1929 to 1933*

Item	1929	1930	1931	1932	1933
Books and periodicals sent to bindery	2,193	3,051	[1] 4,957	4,755	5,715
Volumes laced into binders	1,253	2,429	3,072	3,451	2,725
Current serials added to binders	1,385	1,139	1,487	1,419	1,088
Pamphlets stapled in binders	1,019	875	854	1,209	554

[1] Includes 1,093 volumes which were prepared for binding during May and June 1930, but which could not be sent to the bindery as Department funds for printing and binding were exhausted.

TABLE 10.—*Combined statistics of circulation, 1932 and 1933*

Bureau or office library	Number of books circulated								Current periodicals circulated		Number of borrowers, 1933
	To individuals		To main library		To branch libraries		Total				
	1932	1933	1932	1933	1932	1933	1932	1933	1932	1933	
Main library	20,575	20,364	------	------	33,213	34,011	53,788	54,375	[1]	[1]	848
Agricultural Economics	18,593	18,100	1,155	1,238	211	317	19,959	19,655	[1]	[1]	451
Agricultural Engineering	1,440	1,617	200	154	------	57	1,640	1,828	7,689	12,005	60
Animal Industry	3,604	3,143	239	284	105	134	3,948	3,561	35,322	42,810	72
Chemistry and Soils	6,311	6,166	775	850	74	54	7,160	7,070	44,720	44,868	366
Dairy Industry	1,858	2,004	110	77	23	32	1,991	2,113	28,392	27,455	76
Entomology	4,022	3,938	594	618	2	------	4,618	4,556	7,111	7,628	127
Experiment Stations	2,596	2,433	[1]	[1]	[1]	[1]	2,596	2,433	28,771	26,986	114
Forest Service	2,560	2,540	566	691	1	13	3,127	3,244	7,416	6,470	155
Home Economics	4,767	4,406	406	431	------	------	5,173	4,837	13,342	14,403	73
Plant Industry	[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]	35,831	34,927	[2]
Public Roads	3,336	3,549	1,207	1,584	0	0	4,543	5,133	8,540	11,883	148
Total	69,662	68,260	5,252	5,927	33,629	34,618	108,543	108,805	217,134	229,435	2,490

[1] Figures not available.

[2] The Bureau of Plant Industry library does not maintain a collection of books, as it is in close proximity to the main library. The circulation of books to members of the Bureau is therefore included with those for the main library, but circulation figures are available for current periodicals, as this circulation is handled in the Bureau of Plant Industry library.

TABLE 11.—*Interlibrary loans outside of Washington, D.C., 1924–33*

United States (States, Territories, and island possessions) and foreign countries	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
United States:										
Eastern:										
Connecticut	10	48	53	24	36	24	19	9	54	8
Maine	12	8	1	3	1	10	6	11	14	22
Massachusetts	30	62	62	67	92	116	84	137	112	74
New Hampshire	12	6	1	21	19	12	13	21	11	12
New Jersey	75	92	78	68	106	67	129	95	83	89
New York	136	149	158	188	174	175	217	231	235	218
Pennsylvania	60	75	65	35	108	97	102	118	214	133
Rhode Island	1	15	18	4	6	8	2	0	2	9
Vermont	20	14	19	43	14	46	38	18	17	12
Total	356	469	455	453	556	555	610	640	742	577
Central:										
Illinois	6	25	44	69	27	56	58	59	36	28
Indiana	24	23	41	38	58	25	71	60	28	29
Iowa	82	76	13	38	42	23	24	34	34	33
Kansas	14	18	11	30	14	14	9	20	12	7
Michigan	44	39	40	30	63	46	46	34	33	21
Minnesota	59	70	77	62	47	66	48	33	32	37
Missouri	30	37	54	32	12	42	43	37	30	29
Nebraska	10	25	23	33	26	29	13	16	15	12
North Dakota	15	10	15	5	15	6	9	8	18	22
Ohio	89	86	139	187	161	143	214	200	179	108
South Dakota	1	1		1	1	2	1	1		
Wisconsin	33	88	67	55	74	63	56	82	46	26
Total	407	498	524	580	540	515	592	584	463	352
Southern:										
Alabama	8	3	13	11	4	8	19	15	19	15
Arkansas	23	20	29	47	51	48	32	44	41	22
Delaware	84	103	78	75	63	102	131	128	128	81
Florida	73	80	73	134	107	114	104	104	163	110
Georgia	14	31	35	43	34	44	52	46	74	59
Kentucky	49	23	16	24	8	31	50	37	29	21
Louisiana	10	13	17	13	14	65	140	97	92	115
Maryland	117	65	115	85	105	137	171	126	176	297
Mississippi	5	1	2	18	3	5	3	12	11	6
North Carolina	48	61	39	64	40	43	95	53	87	71
Oklahoma	1	13	15	40	56	31	61	50	48	71
South Carolina	22	20	30	26	34	27	44	41	41	34
Tennessee	8	8	7	3	7	3	6	21	11	31
Texas	19	3	26	17	18	43	26	49	46	60
Virginia	40	52	47	109	48	65	28	58	82	84
West Virginia	15	16	30	15	18	12	12	22	28	31
Total	536	512	572	724	610	778	974	903	1,076	1,108
Western:										
Arizona	11	20	5	20	34	18	6	7	8	7
California	52	47	54	53	64	87	63	65	68	62
Colorado	13	9	15	39	31	17	12	26	9	14
Idaho	4	4	12	24	15	2	32	27	55	17
Montana	26	17	25	37	26	33	30	16	17	23
New Mexico		2	2	8	2			3		
Nevada										
Oregon	6	8	38	35	91	28	31	29	18	16
Utah	45	28	57	47	90	43	31	38	23	36
Washington	17	22	39	30	33	49	25	60	138	58
Wyoming	7	21	3	5	12	8	4	4	18	2
Total	181	178	250	298	398	285	234	275	354	235
Territories and island possessions:										
Alaska				1		1		1	1	1
Canal Zone							8		1	
Guam			1							
Hawaii		1				1				4
Philippine Islands									1	
Puerto Rico	20	17	22	13	279	155	24	20	1	8
Virgin Islands									1	
Total	20	18	23	14	279	117	32	21	5	13
Foreign countries:										
Canada			24	40	44	70	101	57	108	74
Cuba				3						
Other countries	5	12	5	2	5	10	1	1	3	2
Total	5	12	29	45	49	80	102	58	111	76
Grand total	1,505	1,687	1,853	2,114	2,432	2,330	2,544	2,481	2,571	2,361

TABLE 12.—*Number of books borrowed from other libraries, 1932 and 1933*

	1932	1933		1932	1933
In Washington:			In Washington—Continued.		
American Leather Chemists' Association	-------	5	National Museum and Smithsonian Institution	78	56
Army War College	-------	1	Office of Education	5	8
Brookings Institution	1	-------	Pan American Union	5	-------
Bureau of Ethnology	2	3	Patent Office	21	36
Bureau of Fisheris	7	22	Public Health Service	11	17
Bureau of Mines	6	2	Public Library	7	4
Bureau of Railway Economics	1	1	Science News Service	1	-------
Bureau of Standards	33	29	State Department	-------	1
Carnegie Institution of Washington	1	-------	Surgeon General's Office	499	428
Civil Service Commission	-------	1	Tariff Commission	1	-------
Department of Commerce	1	7	Weather Bureau	28	43
Department of Justice	-------	1	Total	5,176	4,822
Federal Reserve Board	1	-------			
Geological Survey	59	58	Outside of Washington	102	77
Institute of Economics	-------	1			
Interstate Commerce Commission	1	-------	Total	5,278	4,899
Library of Congress	4,390	4,070	Average number daily	17	16
National Institute of Health	17	28	Average number monthly	439	408

TABLE 13.—*Interlibrary loans outside of Washington, classified by institutions 1929 to 1933*

	1929	1930	1931	1932	1933
Land-grant colleges and experiment stations	1,186	1,191	1,125	1,276	1,048
Department workers stationed outside of Washington	465	505	583	706	595
Colleges and universities other than land-grant colleges	242	281	245	335	315
Other scientific institutions	228	251	217	237	222
Business firms	136	195	271	154	127
Public libraries and miscellaneous	73	121	40	43	54
Total	2,330	2,544	2,481	2,751	2,361
Photostat copies of articles	230	128	79	112	52
Typewritten copies of articles	18	36	11	12	6
Grand total	2,578	2,708	2,571	2,875	2,419

TABLE 14.—*Statistics of Bureau libraries* [1]

Bureau or office library	Employees	Books	Pamphlets	Periodicals currently received	Registered borrowers	Registered borrowers to whom periodicals are circulated	Shelving	Space occupied
							Linear feet	*Square feet*
Agricultural Economics	21	[2] 61,323		1,931	451	147	[3]	4,790
Division of Cotton Marketing	4	589	[3]	275	37	50	45	576
Agricultural Engineering	1	[4] 2,685	6,000	235	60	32	336	684
Animal Industry	3	[3]		635	72	72	[3]	540
Animal Husbandry Division	1	4,963	5,451	279	68	32	746	630
Chemistry and Soils	4	11,565	[3]	617	366	158	1,770	1,000
Fertilizer and Fixed Nitrogen Investigations	1	[4] 4,300	[3]	113	92	45	587	1,260
Dairy Industry	4	1,323	5,280	372	76	64	180	400
Entomology	3	13,139	14,420	966	127	41	1,733	2,240
Division of Bee Culture	1	2,173	575		[4] 35		342	400
Experiment Stations	8	4,367	81,897	1,122	114	65	1,587	2,650
Forest Service	1	[2] 27,440		175	155	71	1,227	1,142
Home Economics	2	4,225		283	73	71	685	736
Plant Industry	11	[5] 200		673		195	140	650
Public Roads	4	[4] 12,287	[4] 20,280	340	132	148	1,499	912
Solicitor's Office	1							

[1] The Weather Bureau library is administered separately, with the exception that the books and periodicals are purchased from the appropriation of the library of the Department, the sum of $1,000 being set aside each year for this purpose.
[2] Includes pamphlets.
[3] Figures not available.
[4] Approximate figures.
[5] Does not maintain a collection of books.

TABLE 15.—*Financial statement, fiscal years, 1924–33*

RECEIPTS

	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
Source:										
Library appropriation:										
Salaries	$32,660.00	$40,000.00	$38,680.00	$54,680.00	$60,000.00	$69,100.00	$69,300.00	$71,860.00	$74,120.00	$74,120.00
General expenses	30,000.00	30,960.00	29,500.00	29,500.00	24,180.00	26,580.00	32,700.00	32,700.00	36,500.00	31,980.00
Total	62,660.00	70,960.00	68,180.00	84,180.00	84,180.00	95,680.00	102,000.00	104,560.00	110,620.00	106,100.00
Department printing and binding fund	10,621.26	13,171.04	9,983.30	13,173.75	10,045.07	8,199.46	10,614.72	19,944.70	19,001.95	18,669.07
Main library salaries paid by bureaus	12,257.50	15,117.84	16,521.50							
Grand total	85,538.76	99,248.88	94,684.80	97,353.75	94,225.07	103,879.46	112,614.72	124,504.70	129,621.95	124,769.07

EXPENDITURES

Books and serials	11,138.26	13,582.31	14,710.31	14,750.47	13,093.14	14,817.52	18,806.78	19,971.38	19,047.74	[1] 13,607.53
Periodicals	6,916.54	6,937.19	7,184.29	7,517.97	8,845.99	9,061.06	9,431.94	9,351.98	10,402.63	9,039.95
Maps								28.50	8.43	56.30
Index cards	147.37	162.45	169.30	137.88	155.41	165.75	149.98	227.68	299.07	188.97
Furniture, shelving, and miscellaneous equipment	1,738.15	1,908.83	404.77	476.86	1,133.24	821.04	1,569.37	898.32	4,019.44	2,806.80
Traveling expenses	971.06			78.44	108.04		29.64	78.87	29.63	
Freight, express, and trucking service	60.40	126.78	128.09	95.39	107.87	127.97	113.00	125.65	169.42	128.79
Supplies	334.52	501.73	474.40	767.00	750.01	707.35	708.47	651.73	944.77	737.62
Repairs	802.46	513.28	497.44	355.24	326.99	641.74	962.92	228.64	1,831.78	3,223.09
Newspapers	99.32	97.80	99.60			809.90	974.91	1,105.50	784.86	803.80
Telephone and telegraph										258.16
Special and miscellaneous expenses (general chare service and cleaning supplies)	1,440.00	2,775.00	2,700.00	2,760.00	2,760.00	3,300.00	3,300.00	3,300.00	3,300.00	4,599.98
Salaries (exclusive of chare service)	38,295.66	43,219.47	40,993.92	56,626.50	56,895.09	65,226.70	65,952.43	68,365.06	69,333.05	70,173.35
Total	61,943.74	69,824.84	67,362.12	83,565.75	84,175.78	95,679.03	101,999.44	104,333.31	110,170.82	105,624.34
Printing	567.97	444.47	477.32	327.96	438.25	553.00	349.43			997.92
Binding	10,053.29	12,726.57	9,505.98	12,845.79	9,606.82	7,646.46	10,265.29			18,669.07
Main library salaries paid by bureaus	12,257.50	15,117.84	16,521.50							
Grand total	84,822.50	98,113.72	93,866.92	96,739.50	94,220.85	103,878.49	112,614.16			124,293.41
Credit received for duplicates exchanged with book dealers and libraries	954.75	604.35	216.35	653.68	147.30	455.76	335.64	201.96	270.67	98.85
Gifts	12.94	10.75								

Supplies:										
Cleaning and toilet	54.84	70.45	109.31	124.22	104.76	107.62	95.07	84.34	67.10	367.62
Stationery	158.37	55.16		257.85	107.11	208.67	214.74	248.22	385.71	186.64
Miscellaneous office	105.85	302.53	291.99	289.02	488.76	264.74	289.19	280.04	391.03	165.95
Binding material	15.46	73.59	73.10	95.91	49.38	126.32	109.47	39.13	100.93	17.41
Total	334.52	501.73	474.40	767.00	750.01	707.35	708.47	651.73	944.77	737.62
Repairs:										
Carpentry work	314.56	124.24	151.52	57.49	65.43	160.74	188.13	68.88	903.72	2,359.24
Electrical work	203.03	159.95	45.52	60.04	31.46	191.04	241.12	43.50	37.55	125.90
Typewriters	42.46	104.74	86.58	48.00	20.92	27.19	15.43	25.45	36.31	73.39
Painting	166.46	42.55	142.88	120.91	135.05	186.59	124.30	14.38	759.29	496.76
Miscellaneous	75.95	81.80	70.94	68.80	74.13	76.18	393.94	76.43	89.87	167.80
Total	802.46	513.28	497.44	355.24	326.99	641.74	962.92	228.64	1,826.74	3,223.09

[1] Outstanding liabilities for books, periodicals, and serials, $475.66.

U. S. GOVERNMENT PRINTING OFFICE: 1933

REPORT OF THE DIRECTOR OF PERSONNEL AND BUSINESS ADMINISTRATION, 1933

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF PERSONNEL AND BUSINESS ADMINISTRATION,
Washington, D.C., September 9, 1933.

SIR: I submit herewith the report of the work of the Office of Personnel and Business Administration for the fiscal year ended June 30, 1933.

Respectfully,

W. W. STOCKBERGER, *Director.*

Hon. HENRY A. WALLACE,
Secretary of Agriculture.

INTRODUCTION

The salient features of the work in the Office of Personnel and Business Administration during the fiscal year 1933 will be found later in this report, under the respective divisions of the Office. Notwithstanding a sharp reduction in expenditures and in the personnel concerned with the regular activities of the Department, and the numerical reductions apparent in the statistical portions of the report, the establishment of new emergency agencies to try to check the farm decline has resulted in an actual increase in the work of this Office.

Despite successive shocks to the general morale occasioned by the reduction in salaries, the uncertainties regarding impending reorganizations and the fear of loss of employment, the employees of the Department have been assiduous in the discharge of their duties and eager to assist in any possible way in the program for the betterment of the situation in agriculture.

In this Office efforts made to render greater and more effective service, in the face of reduced funds for operation and with a diminished personnel, have been a heavy tax upon the energy and resourcefulness of the entire Office staff, but the burden has been borne with a cheerfulness and an esprit de corps worthy of particular mention here.

BRANCH OF PERSONNEL

DIVISION OF APPOINTMENTS

The Department personnel experienced a turnover of 3.88 percent during the fiscal year 1933, as compared with 5.98 percent during the fiscal year 1932, 7.95 percent during 1931, 9.79 percent during 1930, and 8.62 percent during 1929. Personnel data for the last 3 years are shown in table 1.

TABLE 1.—*Personnel activities of the Department of Agriculture, 1931, 1932, and 1933*

Year ended June 30	Employees on rolls of Department			Field stations	Employees appointed	Separations from the Department
	Departmental service	Field service	Total			
1931	5,639	22,524	28,163	1,451	10,258	7,836
1932	5,664	[1] 21,764	27,428	1,451	6,612	7,425
1933	5,521	[2] 21,023	26,544	1,451	3,915	4,721

[1] Includes 78 in foreign service.
[2] Includes 80 in foreign service.

For the period July 1, 1932, to May 26, 1933, at which time the Crop Production Loan Office was transferred to the Farm Credit Administration, the following personnel actions were handled for that organization:

Appointments	2,870
Separations	2,602
Other actions	2,334

In compliance with the act of Congress (sec. 203, title 2, pt. 2, Public, No. 212, 72d Cong.), it has been necessary to obtain authority from the President to fill positions in the Federal Government, and for the fiscal year ended June 30, 1933, the Department of Agriculture has obtained 465 such authorizations.

During the fiscal year 1933, 144 formal applications for positions were received and circulated throughout the Department.

RECORD OF LEAVE

Statistics for leave during the calendar year 1932 are not available because of legislation changing the procedure of granting annual leave. From January 1 to June 30, 1932, both annual and sick leave were allowed. However, the Economy Act of June 30, 1932, suspended annual-leave rights beginning with July 1, 1932, and continuing during the fiscal year 1933. This suspension was lifted, effective April 1, 1933, by the act of March 20, 1933. From July 1 to December 31, 1932, no annual leave was allowed, absence from duty during this period for reasons other than illness, was without pay and chargeable to the so-called legislative furlough. There was no change in the sick-leave regulations.

WORK INCIDENT TO APPOINTMENTS, TRANSFER, AND PROMOTION

Personnel changes in the Department during the fiscal year 1933 necessitated contacts with the Civil Service Commission, and certificates and authorizations were obtained as indicated in table 2.

TABLE 2.—*Personnel changes in the Department of Agriculture, 1931, 1932, and 1933*

	1931	1932	1933
Certificates from register	1,420	702	74
Reinstatement certificates	385	212	27
Certificates for change in status	619	194	108
Transfer certificates	289	165	69
Authorities for temporary appointments	762	462	94
Authorities for extensions of temporary appointments	432	443	66
Authorities for extensions of suspensions	11	6	6
Civil-service examinations requested	132	26	7

RETIREMENT RECORDS

The Division of Appointments has continued work on the final completion of a new system of retirement records which was installed in the years 1931 and 1932, under which the Civil Service Form 2806 was substituted for the old master retirement card. During the past year it was generally used throughout the service with satisfactory results.

The passage of several far-reaching laws affecting retirement as well as other branches of Government work, notably the Economy Act of June 30, 1932, and the provision for 30-year retirement in the Independent Offices Act of June 16, 1933, has greatly increased the volume of retirement work, and its importance to the personnel of the Department.

Thirty-year retirement adds a new class of separations under the retirement laws and makes it possible for one involuntarily separated after 30 years of service, regardless of age, to receive an annuity less than the payment allowed for retirement at the age of 70 only by the deduction of 3½ percent of the actual gross annuity. This law applies only to those separated (in good standing) on account of reduction of force.

Figures showing retirements for the past 3 years are shown in table 3, and the average annuities paid in the various groups are shown in table 4.

TABLE 3.—*Number of employees retired, 1931, 1932, and 1933*

Year ended June 30	Annuity retirements in class—				Disability retirements in class—				Cases disposed of
	Professional	Subprofessional	Clerical, administrative, and fiscal	Custodial	Professional	Subprofessional	Clerical, administrative, and fiscal	Custodial	
1931	36	88	20	27	7	17	20	3	307
1932	22	41	13	9	8	17	8	10	378
1933	81	132	22	28	9	23	19	15	329

TABLE 4.—*Averages of the annuities in the various groups, 1931, 1932, and 1933*

Group	1931	1932	1933
Professional and scientific	$1,006.77	$1,100.77	$1,114.04
Subprofessional	926.61	972.67	1,012.91
Clerical, administrative, and fiscal	907.88	981.88	963.67
Custodial	749.42	698.57	695.98

Owing to that part of the Economy Act of June 30, 1932, which provides for Presidential approval for continuance in the Government service after retirement age, only four extensions were granted in the Department during the fiscal year 1933. A summary of the continuances for the past 3 years is shown in table 5.

TABLE 5.—*Number of employees who received continuances after reaching retirement age, 1931, 1932, and 1933*

Year ended June 30	Extensions					
	First	Second	Third	Fourth	Fifth	Sixth
1931	53	29	3	1	2	1
1932	60	35	1	0	0	0
1933	1	2	1	0	0	0

NEW ACTIVITIES

The establishment of the Agricultural Adjustment Administration in the Department of Agriculture, pursuant to act of Congress (title 1, Public, No. 10, 73d Cong., approved May 12, 1933), has greatly added to the responsibilities and duties of the Division of Appointments which has assisted in organizing and recruiting the necessary personnel for this new Administration.

OFFICE OF CLASSIFICATION

During the year the Division of Organization and Classification was abolished and the duties, together with part of the personnel, were merged into the immediate office of the Director.

Subsequent to this change the Agricultural Adjustment Administration was organized, which will no doubt increase the classification work of this Office to the maximum of any previous year since its inception in 1924. A summary of this activity over the past 3 years is given in table 6.

TABLE 6.—*Appointments and changes in status of employees of the Department of Agriculture, 1931, 1932, and 1933*

Year ended June 30—	Appointments to new positions	Changes in duties	Changes to vacancies	Appeals	Total
1931	545	430	979	110	2,064
1932	187	320	725	23	1,255
1933	[1] 246	143	104	5	498

[1] 170 positions were allocated during June 1933 in the Agricultural Adjustment Administration.

BRANCH OF BUSINESS AND FISCAL OPERATIONS

THE DEPARTMENT BUDGET

Appropriations provided for the Department of Agriculture for all purposes during the fiscal year 1933 totaled $318,885,991, as compared with $301,554,375 for the fiscal year 1932. The items are given in table 7.

TABLE 7.—*Department of Agriculture appropriations for fiscal years 1932 and 1933, as provided in the Department budget*

Item	1932	1933
Regular appropriations, exclusive of road funds	$91,929,375	$77,980,991
Road construction:		
Regular funds	187,500,000	108,905,000
Provided by Emergency Relief and Construction Act		132,000,000
Emergency relief loans	22,125,000	
Total	301,554,375	318,885,991

The distribution of these funds under group and bureau units is shown in table 8.

TABLE 8.—*Department of Agriculture appropriations for fiscal years 1932 and 1933*

Activity	Fiscal year	
	1932	1933
Ordinary activities:		
Office of the Secretary	$1,322,115	$1,206,547
Office of Information	1,420,961	1,335,800
Library	110,620	106,100
Office of Experiment Stations (exclusive of payments to States)	399,410	294,294
Extension Service (exclusive of payment to States)	1,793,560	1,688,170
Weather Bureau	4,497,720	4,164,038
Bureau of Animal Industry	16,085,195	15,324,947
Bureau of Dairy Industry	796,990	717,448
Bureau of Plant Industry	5,839,238	4,930,874
Forest Service (exclusive of forest roads, payments to States, forest receipts and special funds, and forest-fire deficiency)	15,184,620	10,780,924
Bureau of Chemistry and Soils	2,104,051	1,925,080
Bureau of Entomology	2,863,740	2,471,700
Bureau of Biological Survey	2,229,170	1,756,177
Bureau of Public Roads (exclusive of Federal-aid highways)	179,940	
Bureau of Agricultural Engineering	656,990	618,690
Bureau of Agricultural Economics	7,241,136	6,649,841
Bureau of Home Economics	246,700	233,365
Bureau of Plant Quarantine	3,747,930	2,490,125
Grain Futures Administration	221,480	218,838
Food and Drug Administration	1,810,228	1,716,167
Total	68,751,794	58,629,125
Payments to States (exclusive of road funds and national-forest receipt funds):		
State agricultural experiment stations for research under Hatch, Adams, and Purnell Acts (Office of Experiment Stations)	4,357,000	4,374,000
State colleges of agriculture for extension work under Smith-Lever and supplemental acts (Extension Service)	8,672,936	8,728,096
Forest-fire cooperation (Forest Service)	1,775,000	1,611,580
Cooperative distribution of forest-planting stock (Forest Service)	95,000	79,960
Total	14,899,936	14,793,636
Forest Service receipts and special funds:		
Refunds to depositors	75,000	75,000
National Forest Reservation Commission	500	475
Cooperative work	1,700,000	1,700,000
Payments to States and Territories (national-forest receipts fund)	1,600,000	1,240,000
Payments to school funds, Arizona and New Mexico (national-forest receipts fund)	40,000	40,000
Roads and trails for States (national-forest receipts fund)	600,000	500,000
Total	4,015,500	3,555,475

TABLE 8.—*Department of Agriculture appropriations for fiscal years 1932 and 1933*—Continued

Activity	Fiscal year	
	1932	1933
Special items:		
Fighting forest fires (deficiency)	$4,260,000	$1,000,000
Private claims and relief acts	2,145	2,755
Total	4,262,145	1,002,755
Total, exclusive of road funds and emergency relief loans	91,929,375	77,980,991
Road construction:		
Federal-aid highways:		
Agricultural Appropriation Act	175,000,000	100,000,000
Emergency Relief and Construction Act of 1932		120,000,000
Forest roads and trails:		
Agricultural Appropriation Act	12,500,000	8,905,000
Emergency Relief and Construction Act		10,000,000
Public-land highways (Emergency Relief and Construction Act)		2,000,000
Total	187,500,000	240,905,000
Emergency relief loans:		
Loans to farmers in storm- and drought-stricken areas, Southeastern States	2,000,000	
Agricultural credits and rehabilitation emergency relief loans	20,000,000	
Collection of loans	125,000	
Total	22,125,000	
Grand total	301,554,375	318,885,991

EMERGENCY APPROPRIATIONS UNDER THE AGRICULTURAL ADJUSTMENT ACT

The Agricultural Adjustment Act of May 12, 1933, provides a straight appropriation of $100,000,000, available until expended, for carrying out the purposes of this act, and authorizes the Secretary of the Treasury to advance such additional amounts as may be necessary for "administrative expenses, rental and benefit payments, and refunds of taxes", to be reimbursed from processing-tax receipts. Under the latter authority the Secretary of the Treasury advanced up to June 30, 1933, the sum of $500,000, making a total of $100,500,000 available to the Agricultural Adjustment Administration for the fiscal year 1933. A comparatively small part of this amount, however, was expended during that fiscal year. The Agricultural Adjustment Act also appropriates the proceeds derived from all taxes imposed under the act for carrying out its purposes. In addition, the President is authorized to allocate not to exceed $100,000,000 from the appropriations provided by the National Industrial Recovery Act for carrying out the Agricultural Adjustment Act and for the purposes of the Farm Credit Administration.

DIVISION OF ACCOUNTS AND DISBURSEMENTS

During the year the Division of Accounts and Disbursements disbursed $233,059,062.88 which required the examination and payment of 357,261 vouchers and pay rolls and the issuance of 627,562 checks on the Treasurer of the United States. As compared with the preceding fiscal year, this was a decrease of $30,276,576.41 in the amounts disbursed, a decrease of 36,219 vouchers and pay rolls examined and paid, and a decrease of 30,776 checks issued.

The large decrease in disbursements was due in part to a curtailment in general work activity and a reduction of approximately $23,000,000 in payments to States for Federal-aid highway construction.

A comparison of the number of vouchers paid and checks drawn with the preceding 5 years is shown in table 9.

TABLE 9.—*Number of vouchers paid and checks drawn, fiscal years 1928 to 1933, inclusive*

Fiscal year	Vouchers paid	Checks drawn	Fiscal year	Vouchers paid	Checks drawn
1928	[1] 267,143	[1] 441,025	1931	[2] 374,349	648,205
1929	292,947	473,384	1932	393,480	658,338
1930	333,059	546,145	1933	357,261	627,562

[1] Exclusive of 215,000 vouchers paid and a like number of checks issued in connection with the campaign for control of the European corn borer.
[2] Exclusive of 89,000 vouchers paid and a like number of checks issued in connection with emergency drought relief and rehabilitation loans to farmers.

The disbursing clerk received from the various bureaus of the Department and deposited in the Treasury to the credit of the proper appropriations or the required general fund revenue total collections of public moneys, exclusive of $3,899,971.80 in special deposits, totaling $3,501,937.48. These collections consisted of $2,153,138.75 in repayments to the proper appropriations of emergency-relief loans made to farmers in flood, storm, and drought-stricken areas, $382,-121.27 in repayments to other appropriations and funds, and $966,677.46 in miscellaneous revenues accruing from sales of Government property, services rendered the public, fees for the official inspection, grading, or classification of commodities, interest on emergency-relief loans, and from other sources.

These collections involved the receipt, handling, verification, and posting of 7,861 schedules of collections (including 1,663 from the Washington Regional Seed Loan Office), comprising 53,488 individual remittances in the form of checks, drafts, money orders, and currency transmitted to this Office by the various bureaus of the Department. In addition 3,970 schedules of collections were received from the regional seed-loan offices at Memphis, Tenn., St. Louis, Mo., Dallas, Tex., Minneapolis, Minn., Salt Lake City, Utah, Spokane, Wash., and New Orleans, La., covering remittances deposited through the Federal Reserve banks or branches of these cities to the credit of the disbursing clerk's account with the Treasurer of the United States. These also had to be verified, receipted, and posted, bringing the total to 11,831. A total of 1,411 certificates of deposit were prepared and transmitted to the Treasurer of the United States and accounted for in the manner prescribed by the General Accounting Office.

OFFICE OF ACCOUNTS (OFFICE OF THE SECRETARY)

The Office of Accounts continued to function during the fiscal year 1933 in the same capacity as previously except that the volume and scope of work increased during the latter months due to extra duties added in connection with the Agricultural Adjustment Administration.

A summary of the routine activities of this Office are shown in tables 10, 11, and 12.

TABLE 10.—*Audit work accomplished, 1931, 1932, and 1933*

Fiscal year	Claims audited	Purchase orders preaudited	Contracts audited	Items involved
1931	15,526	5,869	266	168,745
1932	15,115	5,277	226	167,481
1933	14,482	5,227	182	[1] 120,406

[1] Preaudit before release of 5,409 commitments.

TABLE 11.—*Record of pay roll and miscellaneous items, 1931, 1932, and 1933*

Fiscal year	Pay rolls prepared	Pay roll items	Letters of authorization written	Collection claims filed	Transportation requests issued	Bills of lading issued
1931	3,138	50,379	635	186	6,237	1,918
1932	3,203	51,802	507	301	5,785	1,711
1933	3,434	52,592	2,028	293	5,862	1,268

TABLE 12.—*Funds under direct and indirect control of Office of Secretary, 1931, 1932, and 1933*

Fiscal year	Aggregate amount	Warranted to States	Offset by States	Supplementary State funds
1931	$33,800,259.97	$13,012,936.00	$6,192,936.00	$8,813,102.18
1932	34,278,672.98	13,255,717.00	6,774,514.02	9,000,000.00
1933	32,092,729.41	13,181,927.71	6,547,090.28	7,204,760.99

Audited documents passing through the bookkeeping section involved slightly less than 600,000 entries, but the preparation of regular period and special financial and statistical statements showed considerable increase. During the year a special tabulated statement or chart, long needed for reference purposes, was prepared showing all appropriations made to the Office of the Secretary, Office of Experiment Stations, Office of Information, and the Extension Service since the organization of the Department of Agriculture.

On July 1, 1932, the Office assumed the direction of, and responsibility for, cost-accounting work at the Mechanical Shops, a section being organized to carry on the work, under an accounting system and procedure recommended by the General Accounting Office after a prolonged study in which this Office collaborated. Table 13 indicates in a general way the nature and volume of the documents and transactions handled by the Cost Collection Unit during the fiscal year 1933.

TABLE 13.—*Partial record of Cost Collection Unit documents handled during fiscal year 1933*

Time slips	Material issue slips	Drayage orders	Rubber-stamp requests	Job cost sheets	Individual bills rendered	Overhead application	Miscellaneous
60,000	24,000	10,000	5,786	11,536	16,250	16,250	26,550

In addition to the routine work the Cost Collection Unit also prepared a large number of periodical and special statements showing the monthly and progressive status of the work.

Following approval of the Agricultural Adjustment Act, this Office was designated to handle the accounting and auditing for the Administration's general expenditures with particular reference to its cooperative field activities, and this has considerably more than trebled every phase of office work.

As an incident to the general operation of the Office the File Section received, sorted, and filed alphabetically, numerically, or topically an average of more than 500 papers daily, cleared transfer files for the period since July 1, 1915, of all correspondence having no further value as a record, received from the disbursing officers for the Alaska, Guam, and Virgin Islands Experiment Stations their complete financial records from the organization of the stations to June 30, 1932, and distributed them to the permanent files of the Department.

In addition to the regular work a large amount of accounting-survey and form-construction work was carried on in connection with the General Accounting Office study of operating conditions at the Mechanical Shops, which resulted in a complete revision of methods and forms and the installation of a new cost-accounting system.

DIVISION OF PURCHASE, SALES, AND TRAFFIC

During the year further progress was made toward centralization, in the Division of Purchase, Sales, and Traffic, of the supply activities of the Department. Work of this type for one of the larger bureaus, Agricultural Economics, was taken over, and an entire floor, approximately 50,000 square feet, in the Federal warehouse was occupied. The execution of centralization plans was suspended, however, upon the President's announcement, near the end of the special session of Congress, that a single procurement agency for the Government as a whole was to be set up in the immediate future.

An account of the operations of the division and a comparison with those of previous years are given in table 14.

TABLE 14.—*Purchases, sales, and other activities of the Division of Purchase, Sales, and Traffic, 1931, 1932, and 1933*

Item	1931	1932	1933
Bid Section:			
Bid transactions—number	4,456	4,000	3,000
Flow of bids:			
First quarter—percent	24	24	28
Second quarter—do	17	15	17
Third quarter—do	21	20	20
Fourth quarter—do	38	41	35
Bureau purchase in excess of $500 approved—number	150	129	70
Aggregate amount—dollars	[1] 200,000	163,742.53	53,911.66
Forest-road contracts examined prior to approval by Secretary—number	167	65	145
Aggregate amount—dollars	6,500,000	3,274,854.68	10,761,152.08
Definite quantity purchases of auto tires and tubes—do	100,000	[2] 94,000.00	66,978.19
Definite quantity purchases of other supplies—do	22,358	21,768.33	20,076.66
Value of surplus field property transferred to other departments—dollars	[3] [4] 158,032.87	34,875.45	4,670.00
Value of surplus field property received from other departments—dollars	[4] 51,341.32	179,018.40	83,642.00
Value of District of Columbia property transferred from one bureau to another in Department—dollars	4,750.33	3,000.00	8,400.00
Initial value of worn-out property transferred to General Supply Committee—dollars	25,597.33	20,782.47	57,713.00
Food samples destroyed—number	786	1,275	2,755
Traffic Section:			
Freight routing furnished:			
Less than carload—do	[5] 4,740	[5] 4,149	4,001
Carload—do	[5] 220	[5] 205	383
Rates furnished:			
Freight—do	[5] 6,824	[5] 6,443	6,982
Express—do	[5] 150	[5] 263	186
Passenger—do	[5] 1,285	[5] 1,085	987
Parcel post—do	[5] 100	[5] 75	80
Air—do	[5] 10	[5] 20	50
Itineraries furnished—do	[5] 98	[5] 134	500
Central Supply Section:			
Stock issues during year—dollars	205,017.92	254,261.01	154,591.52
Purchase orders issued to maintain stocks—number	6,578	1,569	7,079
Purchase orders for other activities—do		5,174	
Money value involved, all purchase orders—dollars	437,018.73	593,462.00	565,131.44
Experimental byproducts sold:			
For deposit to miscellaneous receipts—dollars	34,026.42	29,292.60	26,555.74
For cooperators—do	6,795.28	2,734.22	767.56

[1] More than the amount given.
[2] Estimated.
[3] Contained release of 1927 corn-borer equipment.
[4] 11 months' record.
[5] Approximate figure.

BID TRANSACTIONS

The decrease in the number of bid transactions from the preceding year (about 25 percent) was due principally to three causes: (1) During the year consolidated purchases of automotive equipment, of paper for field use, and of hydrogen gas for the Weather Bureau, and an extension of general contracts for gasoline in the field, materially reduced the number of solicitations and awards; (2) a like effect resulted from the Secretary's order permitting the Forest Service to conduct its own purchasing in connection with emergency-conservation work, since such purchases, in a measure at least, obviated the necessity for routine purchases ordinarily made through this Division; (3) the decreased volume of Bureau purchasing during the final quarter reflected the efforts of the Department to decrease its supplies in equal step with its curtailment of general activities.

AUTOMOTIVE EQUIPMENT

The estimates of the Department for the purchase of passenger-carrying vehicles during the fiscal year 1933 aggregated $250,000, but of this total authorization approximately $20,000 remained unused at the end of the fiscal year. The estimates for 1934 were cut by the Department to $217,440. In the preparation of the latter estimates the needs of the several bureaus were not, as heretofore, covered in a single paragraph at the end of the bill but instead were separately indicated in the various bureau sections of the appropriation text. This new form of presentation of course had the approval of the Bureau of the Budget

and the chairman of the Congressional committees, the thought being that, because of the substantial amounts involved, bureau officials should supplement the usual general presentation with separate explanatory statements.

By assembling in two general procurements the bulk of the Department's need for automotive equipment, both passenger-carrying and truck, an estimated saving of at least $70,000, over and above the discounts usually obtainable, was made.

SURPLUS PROPERTY

During the latter months of the year, the Division thoroughly canvassed the various bureaus for the purpose of segregating surplus furniture and office equipment in order that they might be reconditioned and in readiness for use by the Agricultural Adjustment Administration when legislation creating that activity became effective. By thus anticipating the needs of the new organization delays in getting under way due to equipment needs were minimized.

TRAFFIC ACTIVITIES

This section supervises and directs the traffic operations of the bureaus of the Department. It makes claim for loss or damage, traces for delayed or lost shipments, diverts shipments in transit, arranges for special cars or car service, and secures from the Federal Traffic Board for the bureaus and offices of the Department net freight rates necesssary to making awards in the purchase of supplies, or in supplying other costs in shipping.

It keeps the shipping officers advised of changes in handling local shipping or local rates by rail, water, and truck, and furnishes such rates and shipping instructions.

SUPPLY WORK

During the year the Central Supply Section greatly improved its facilities for handling supply work. In July 1932 the Section moved from the basement and first floor of the Administration Building to more commodious quarters on the first floor and in the basement of the South Building. In October of the same year it also occupied the east half of the fourth floor of the Federal Warehouse, and when this additional space was found to be inadequate for this Department's needs the west half of the same floor was made available for storage and issue activity.

After occupancy of the space allotted in the Federal Warehouse the storage and issue work, including stocks, of the Bureaus of Agricultural Economics and Biological Survey was absorbed. Further consolidations have been held in abeyance pending developments in connection with the proposed consolidation of all Government supply activities in a procurement division of the Treasury Department.

It will be noted that the Section's purchases during the fiscal year 1933 are approximately the same as during 1932. This is accounted for by the large volume of purchase work necessary in connection with emergency organizations, notably the Crop Production Loan Office and the Agricultural Adjustment Administration.

SURPLUS EXPERIMENTAL MATERIALS

During the year the Division, operating through a department store, disposed of surplus materials resulting from experimental work at the nearby farms of the Department, realizing net proceeds aggregating $26,555.74 for deposit in the Treasury to the credit of miscellaneous receipts. During the same period and through the same channel it disposed of similar material developed in connection with cooperative work, in the amount of $767.56, the proceeds being returned to the cooperators. All such material consisted chiefly of dairy and poultry products, meats, fruits, and vegetables.

COORDINATING BOARDS

During the year the chief of the Division continued to function as the Department's representative on the Federal Specifications Board, the Federal Purchasing Board, the General Supply Committee, and the Federal Standard Stock Catalog Board, while the traffic manager functioned as the Department's representative on the Federal Traffic Board, and one of the Division's staff served as a member of the Envelop Committee of the Post Office Department.

DIVISION OF OPERATION

Appropriations for the Office of the Secretary for the fiscal year 1933 totaled $1,206,547 and expenditures $1,001,945 as compared with $1,449,102 and $1,362,412, respectively, for the fiscal year 1932.

GENERAL ACTIVITIES

The two completed units of the South Building, the Administration Building, and the corridors and men's toilets of the east and west wings aggregate 556,971 square feet of space which is cleaned daily. Expenditures for salaries of the cleaning force aggregate $93,615.46, with reimbursements in the amount of $35,574.77. Expenditures for equipment amounted to $4,721.78 and for supplies $2,023.90. Waste-paper sales amounted to 539,920 pounds, and receipts from this source were $517.01.

The volume of correspondence handled by the Secretary's file room has increased rapidly in recent months. The chief of this section cooperated with the Agricultural Adjustment Administration officials in the development and installation of a filing system for that organization, also the establishment of a mail collection and distribution system for the various units of the Administration.

The cost of operating the guard force for the fiscal year 1933 was $112,718.93, as compared with $115,684.70 for 1932.

MECHANICAL SHOPS

The outstanding performance of the mechanical shops during the fiscal year was the construction of the exhibits for the Century of Progress Exposition at Chicago. This work was completed and shipped in time for erection prior to the opening of the exposition. The labor costs for the preparation aggregated $16,298.89, the cost of materials involved an expenditure of $4,159.66, a total of $20,458.55.

Table 15 furnishes a comparison of the work performed by the mechanical shops (including motor-transport service) during the fiscal years 1931, 1932, and 1933.

TABLE 15.—*Value of work performed by the mechanical shops, 1931, 1932, and 1933*

Item	1931	1932	1933	Increase or decrease, 1933 over 1932
	Dollars	*Dollars*	*Dollars*	*Percent*
Gross expenditures	367,363	352,184	306,841	−13
Reimbursable work	227,487	212,199	181,677	−14
Shop requests (number)	13,861	12,365	13,500	+9

TELEGRAMS AND TELEPHONE CALLS

On August 20, 1932, the Department's telephone and telegraph section was moved from the west wing of the Administration Building to the fifth floor of the South Building, and on the same date the telephone switchboard was changed from the manual system to the automatic, or direct dialing system. Since this change eliminated the branch-to-branch and outgoing trunks and tie-line calls from the board, it enabled the Department to dispense with the services of three telephone operators. On April 19, 1933, the Arlington Experiment Farm telephone system was also changed from the manual to the automatic, with apparent increase in operating service for the 36 main and 7 extension stations located at this point.

The number of telegraph messages handled and the number of telephones in service, in comparison with other years, are given in table 16.

TABLE 16.—*Number of telephones in use and telegraph messages handled, 1929 to 1933, inclusive*

Year	Telephones			Telegraph messages, incoming and outgoing
	Main stations	Extension stations	Total	
1929	700	762	1,462	49,913
1930	721	789	1,510	50,430
1931	807	905	1,712	61,035
1932	918	941	1,859	62,462
1933	979	938	1,917	60,257

Based on traffic counts made at various times during the year, table 17 represents an estimate of the distributions of telephone calls made as compared with 1932.

TABLE 17.—*Distribution of telephone calls made in the Department of Agriculture, 1932 and 1933*

Type of call	Estimated number of calls made	
	1932	1933
Branch-to-branch	1,528,675	[1]
Outgoing trunks	199,979	254,245
Outgoing Government trunks	57,619	62,635
Incoming trunks	463,386	[2] 552,300
Incoming Government trunks	105,507	97,800
Outgoing tie lines	193,402	[1]
Incoming tie lines	149,494	[2] 210,200
Outgoing long-distance and toll	----------	[2] 12,123
Incoming long-distance and toll	----------	[2] 10,250

[1] Since the introduction of the automatic system no tally can be made of such calls.
[2] These calls handled by operators.

The staff actually checked and audited 150,532 telegrams, for which 248 combined vouchers were prepared, amounting to $80,589.16. For the fiscal year 1932 there were 143,070 telegrams and 228 combined vouchers representing expenditures of $77,516.21.

There were 200 telephone rental vouchers audited and passed to the various bureaus and offices for payment aggregating $42,050.88, and 24 long-distance telephone-toll bills involving an expenditure of $10,659.05.

REAL ESTATE AND HOUSING

The continued development of the Federal building program has resulted in the occupation of a number of completed structures, while tentative plans and approved drawings for a still larger number of buildings have been examined. This has resulted in an increase in the amount of the space occupied in Federal buildings though the program has not developed with sufficient rapidity to effect the amount of commercial space rented. It is particularly interesting to note that although the commercial area leased was increased by 137,083 square feet this rental was accomplished at a reduction of $104,862. Such a decrease is in part attributable to the general lowering of rental rates, but it is believed that a material portion of this saving is due to the introduction of the requirement for competition in leasing.

A tabulation by bureaus of building space occupied by the Department and cost of rentals for the year 1932 as compared with 1933, is not feasible (see report of Sept. 6, 1932, p. 11, table 15); however, the situation as it exists in 1933 is shown in table 18.

TABLE 18.—*Space occupied by Department of Agriculture and cost of rentals, 1933*

Bureau or organization	Federal buildings		Rented buildings			
	In District of Columbia	Outside District of Columbia	In District of Columbia		Outside District of Columbia	
			Area	Rental	Area	Rental
	Square feet	*Square feet* [1]	*Square feet*	*Dollars*	*Square feet*	*Dollars*
Agricultural Adjustment Administration	65,982					
Agricultural Economics	241,859	80,169			144,607	98,338
Agricultural Engineering	12,658	7,127			30,431	6,510
Animal Industry	89,436	67,730			30,636	32,966
Biological Survey	28,929	18,141			25,569	9,426
Chemistry and Soils	68,367	5,542	82,895	16,000	13,319	3,960
Dairy Industry	24,606				9,700	2,479
Entomology	53,528	13,188			175,393	58,516
Experiment Stations	16,399	480				
Extension Service	68,057	111,410				
Farmers' Seed Loan [2]						
Food and Drug Administration	53,873	61,707			11,386	15,283
Forest Service		207,646	54,971	37,296	560,263	146,801
Grain Futures Administration	3,834	1,217			5,937	9,364
Home Economics	29,466					
Office of Information	50,048					
Library	48,713					
Plant Industry	273,429	10,351			40,054	17,924
Plant Quarantine	5,111	21,777	27,930	[3]	221,119	51,972
Public Roads	23,552	44,124	36,909	15,000	41,883	44,017
Secretary	232,656	4,090			1,069	1,062
Weather Bureau	47,775	118,954	2,224	1,000	71,055	90,913
Total	1,438,278	773,653	204,929	69,296	1,382,421	589,531

[1] Exclusive of buildings owned by Department of Agriculture.
[2] Transferred to Farm Credit Administration May 27, 1933.
[3] Rental paid by another department.

A summary of total space occupied by the Department of Agriculture and cost of rentals for the years 1931, 1932, and 1933 is shown in table 19.

TABLE 19.—*Space occupied by Department of Agriculture and cost of rentals, 1931 to 1933, inclusive*

Year	Federal buildings		Rented buildings			
	In District of Columbia	Outside District of Columbia	In District of Columbia		Outside District of Columbia	
			Area	Rental	Area	Rental
	Square feet	*Square feet*	*Square feet*	*Dollars*	*Square feet*	*Dollars*
1931	1,027,686	429,140	326,629	133,945	1,317,114	745,692
1932	1,331,041	601,727	217,817	72,051	1,245,338	694,393
1933	1,438,278	773,653	204,929	69,296	1,382,421	589,531

U.S. GOVERNMENT PRINTING OFFICE: 1933

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REPORT OF THE CHIEF OF THE BUREAU OF PLANT INDUSTRY, 1933

United States Department of Agriculture,
Bureau of Plant Industry,
Washington, D.C., August 25, 1933.

Sir: I have the honor to submit herewith a report of the work of the Bureau of Plant Industry for the fiscal year ended June 30, 1933.

Respectfully,

William A. Taylor, *Chief.*

Hon. Henry A. Wallace,
Secretary of Agriculture.

OBJECTS OF PLANT AND CROP RESEARCH

The agriculture of the United States is remarkable for the wide range of crops even more than for the quantity of them produced. While the greater part of our agriculture is more or less derived from that of western Europe, in comparatively few instances have European crops and European methods been found directly and permanently adapted to this country. The breeding and selection of crop plant varieties suitable for regional utilization in the United States and the development of distinctly American methods of production have been the primary reasons for the rapid and remarkable development of diverse agricultural products. Under present conditions, the fundamental need is for better understanding of the biological phases of production in order to accomplish the stabilization of both quantity and quality of raw products that will be required to meet the consuming demand of both foreign and domestic markets.

The popular impression that agricultural crop research is concerned solely with increasing per-acre production is incorrect. While problems of more efficient production and larger production per acre have received much attention, the primary objectives of the greater part of the research carried on by the Bureau of Plant Industry are and should continue to be—

(1) Improvement in quality of the product reaching the consumer.

(2) Mitigating the damage caused by uncontrollable weather hazards through better regional adaptation of crops and varieties of crops.

(3) Elimination or reduction of the formerly uncontrollable hazards of plant disease epidemics and losses from insects and other pests.

The control of plant diseases through the breeding of resistant varieties of crops is less spectacular than some other agricultural achievements, but the results of recent years establish this as the most economical and most effective method of avoiding increasing losses in regions where climatic and other factors require large acreage of the same crops year after year. In the development of the disease-resistant crops not only the advantage of disease resistance is secured but improved quality may be secured at the same time by plant breeders. A very impressive record is available of the varieties of wheat and other small grains, corn, cotton, forage, and other widespread agricultural crops that have added enormously to the Nation's wealth as the result of research of the Federal and State agricultural agencies.

The great variety of problems under investigation in the Bureau of Plant Industry renders even a comprehensive summary of its activities impracticable in the space of this report; accordingly only a few of the activities that lend themselves to brief description have been summarized in order to indicate some of the conspicuous achievements of the year. Modifications of the work described are followed in other research activities that range all the way from preparing

detailed instructions for the benefit of county agents or others directly interested in applying improved methods of crop production to the more difficult and more time-consuming fundamental researches of genetics, plant physiology, and plant pathology, upon which the more practical improvements in crop production are eventually developed. For a more comprehensive outline of the accomplishments of the year, attention is directed to the subjects covered in the appended list of articles by specialists of the Bureau that have appeared either in publications of the Department or in outside periodicals.

ORGANIZATION OF THE BUREAU

The work of the Bureau has been carried on by the following organization:

Office of the Chief	William A. Taylor, chief of Bureau.
	K. F. Kellerman, associate chief of Bureau.
	H. E. Allanson, assistant chief of Bureau.
Arlington Experiment Farm	E. C. Butterfield, senior horticulturist and superintendent in charge.
Barberry Eradication	F. C. Meier, principal pathologist in charge.
Blister Rust Control	S. B. Detwiler, principal pathologist in charge.
Botany	F. V. Coville, principal botanist in charge.
Cereal Crops and Diseases	M. A. McCall, principal agronomist in charge.
Citrus Canker Eradication	Directed by associate chief of Bureau.
Cotton, Rubber, and Other Tropical Plants	O. F. Cook, principal botanist in charge.
Drug and Related Plants	W. W. Stockberger, principal physiologist in charge.
Dry Land Agriculture	C. E. Leighty, principal agronomist in charge.
Egyptian Cotton Breeding	T. H. Kearney, principal physiologist in charge.
Fiber Plant Investigations	L. H. Dewey, senior botanist in charge.
Forage Crops and Diseases	A. J. Pieters, principal agronomist in charge.
Foreign Plant Introduction	K. A. Ryerson, principal horticulturist in charge.
Forest Pathology	Haven Metcalf, principal pathologist in charge.
Fruit and Vegetable Crops and Diseases	E. C. Auchter, principal horticulturist in charge.
Gardens and Grounds	J. W. Byrnes, assistant in charge.
Genetics and Biophysics	G. N. Collins, principal botanist in charge.
Mycology and Disease Survey	C. L. Shear, principal pathologist in charge.
Nematology	G. Steiner, principal nematologist in charge.
Phony Peach Eradication	Directed by associate chief of Bureau.
Seed Investigations	Edgar Brown, principal botanist in charge.
Sugar Plant Investigations	E. W. Brandes, principal botanist in charge.
Tobacco and Plant Nutrition	W. W. Garner, principal physiologist in charge.
Western Irrigation Agriculture	C. S. Scofield, principal agriculturist in charge.

FRUITS

APPLES

FACTORS AFFECTING COLOR

Color is recognized as one of the principal factors determining the market quality and value of apples. Effects of various practices in orchard management on the color of the fruit have received a good deal of attention experimentally. Adjusting the crop on the tree so as to leave a large foliage system per fruit has resulted in the production of fruit of the best possible color for the variety. Also, sufficient moisture to maintain the foliage system in a good condition of functioning throughout the season has resulted in greatly improved color of the fruit as compared with similar trees that suffered from lack of water during the latter part of the growing season. On the other hand, excessive moisture has tended to retard or to reduce color development. Applications of nitrogen made sufficiently early to influence set of fruit and tree growth for the season have tended to reduce color development, although on well-thinned trees this reduction has been only moderate. The results suggest that poor color obtained by many growers after making fairly heavy applications of nitrogenous fertilizers is due to a combination of a heavier set of fruit coupled with increased growth and greater shading of the crop. With abundant soil moisture this tendency is increased. The results also indicate that apple trees supplied with available nitrogen are better able to resist drought than if nitrogen is lacking.

CITRUS

STOCKS FOR SATSUMA ORANGES

As is well known, the trifoliate orange has been very generally utilized as an understock in propagating Satsuma orange trees. This stock is well adapted to the fairly heavy loam soils with clay subsoils that prevail throughout most of the Gulf coast region where Satsuma oranges are grown, but it is not well suited to the more sandy types of soil and the heavy marl soils that occur in some sections.

In an effort to find hardy stocks that would permit the growing of Satsuma oranges at least for home use on soils to which the trifoliate orange is not adapted, tests have been under way for a number of years to determine the suitability of other possible stocks. Experimentally a number of citrus hybrids have now shown a large measure of suitability for use in propagating varieties of the Satsuma type. These hybrids are derivatives of the trifoliate orange either directly as one of the parents or as multiple hybrids into which this species has entered in some degree. Hybrids designated as citrange, citrumelo, citradia, and a complex hybrid between the citrange and the kumquat all give considerable promise, and it is expected that on further test some of them will prove of value in extending the cultivation of Satsuma oranges. The citrange is already in commercial use not only for the Satsuma varieties but for other citrus varieties.

NAVEL-ORANGE SCAB

In the United States the sweet orange, including the Washington Navel, is highly resistant or immune to the common citrus scab, sometimes called sour scab, a disease that has caused heavy losses to the citrus industry in the Gulf States. On the basis of severely diseased specimens received from Sao Paulo, Brazil, one of the largest citrus-growing regions in that country, a scab disease of the navel orange has been investigated and found to be similar to, although distinct from, citrus scab. It is called navel-orange scab, and its pathogene has been diagnosed as *Sphaceloma fawcettii viscosa* Jenkins. In Brazil the disease affects fruits of the navel orange, often rendering them unmarketable. Leaves are apparently not affected. The importance of avoiding the introduction of the causal fungus of this or other South American forms of citrus scab into the United States is apparent.

STEM-END ROT

It has been found that losses from stem-end rot of citrus fruit in Florida could be very materially reduced and the development of the disease during the marketing or storage period could be practically controlled by dipping the fruit in a 5-percent solution of borax at 110° F. as it is received from the orchards and before it is subjected to the coloring treatment. The commercial practice has been to use the borax treatment after coloring and before packing, as a preventive of blue-mold decay; this practice has had little or no effect on stem-end rot. By modifying the method so that the fruit is treated before it is subjected to the high temperature and humidity and the gas treatment in the coloring rooms, which provide ideal conditions for the development of stem-end rot, it has been possible to reduce the losses from this type of decay more than 75 percent. This method has proved fully as effective as precooling after packing, if not more so, in controlling stem-end rot. The potential saving to the Florida citrus industry from this work is estimated to be at least a million dollars annually.

CITRUS-CANKER ERADICATION

With the exception of an outbreak in Texas, citrus canker was not found during the year in any of the States cooperating in the campaign for the eradication of this disease, namely, Alabama, Florida, Louisiana, Mississippi, and Texas.

In August 1932 Texas reported finding 18 infected orange trees near League City, Galveston County. Near Algoa, in Galveston County, in December 1932, 13 orange and 17 grapefruit trees and 1 lemon tree were found infected, and in January 1933 the disease was found on trifoliate orange on three abandoned or isolated properties. The heavy freeze of February 1933 killed all citrus plants in this vicinity. Near Alvin, Brazoria County, in February and March 1933, citrus canker was found on trifoliate orange on five abandoned properties, and the infected plants were destroyed by digging and burning.

At the close of the fiscal year no cases of citrus canker were known to exist in any of the cooperating States; but, because of occasional isolated infections such as those found in Texas, a close reinspection of all citrus properties in the vicinity of any recent infections should be continued for several years.

DATES

The fact that the time of ripening of dates can be strikingly influenced by the pollen that is used in artifically pollinating the blossoms was shown experimentally a few years ago. This important effect of pollen on the fruit has been termed metaxenia. During the past year large-scale use of specially selected

pollen was made in commercial date plantings in the Coachella Valley of California, the largest date-growing district in the United States. So successful was the control of the period of ripening through the metaxenic effect of pollen that it appears inevitable that its use will be rapidly extended to date plantings in other parts of the Southwest.

Progress has been made also in the effort to discover and develop rain-resistant varieties of dates that may be grown and handled successfully in areas where some of the choicer varieties adapted to the more arid sections cannot be produced successfully. There have come to light at least two varieties, the Braim and a seedling that originated in Arizona, which, though not strictly rain-resistant, have qualities that make them promising for some of the warmer regions not sufficiently arid to meet the requirements of the varieties adapted to the Coachella Valley and other districts in the Southwest where date growing has already been successfully established.

PEACHES

GROWTH AND DEVELOPMENT

A study of leaf-to-fruit ratios in the peach shows than an increase in leaf area per fruit produces an increased size of fruit and improvement in flavor. On ringed branches of the Hiley variety a tendency was noted for such an increase in size of fruit in comparison with the attending leaf areas with ratios from 10 to 45 leaves per fruit. On unringed branches where the fruit load averaged about 25 leaves per fruit the size was intermediate between that for ringed branches having 10 and 20 leaves per fruit. Chemical analyses showed that with increased leaf-to-fruit ratios there was an increase of fractions of total solids, total sugars, and titratable acidity. It has been observed further that increasing the leaf area per fruit tends to result, on ringed branches at least, in the differentiation of a larger number of fruit buds.

STOCKS

In some of the peach-growing sections of the South, the nema, or nematode, is a very serious menace to peach trees propagated on the understocks in common use. Peach growers suffer heavy losses as a result of the destructive effects of the nema working on the roots. The importance of a nema-resistant rootstock that is otherwise desirable is therefore readily apparent.

In an extensive test of peach understocks there have appeared two (introductions by the Bureau of Plant Industry) which thus far seem to be very promising, namely, S.P.I. 61302 (a cross between the Bolita peach and a nectarine) and S.P.I. 63850 (the Shalil peach). Trees propagated on these two rootstocks and now 5 years old are superior to trees of the same age propagated on the ordinary seedling peach understocks. The Shalil stocks have thus far proved 100 percent nema-resistant on ground where the usual peach understocks were heavily infested. If further tests of these stocks confirm present indications, their value to the peach industry in the South can hardly be overestimated.

PHONY PEACH ERADICATION

The campaign for the eradication of the phony peach disease, begun in 1929 in cooperation with the Georgia State Board of Entomology, was continued during the past year and extended to all areas known to be infected with this disease, and 36,070 infected trees were found during the 1932 season, as follows: In Alabama, 136; Arkansas, 278; Florida, 2; Georgia, 35,112; Illinois, 12; Missouri, 17; North Carolina, 18; Oklahoma, 3; South Carolina, 60; Tennessee, 19; Texas, 413.

The disease is most severe on the Fort Valley Plateau in Georgia, an area extending from Bibb County on the north to Montezuma in Macon County on the south, and from eastern Crawford County easterly about half-way across Houston County. In other sections where the disease has been found the phony trees are rather widely scattered.

In 127 orchards containing 911,550 trees in four counties in the heavily infected area of the Fort Valley plateau, the number of phony trees found in 1930 was 50,544, and in 1932 it was 16,815, a reduction of nearly 67 percent as a result of 2 years of eradication work. In 289 orchards containing 629,413 trees in 20 counties in the more lightly infected area of northern Georgia, 44 phony trees were found in 1929 and only 7 in 1932 after 3 years of eradication work. These

figures indicate that distinct progress has been made in eradicating the disease, but because of widely varying conditions in different parts of the territory affected it is impossible to judge as to how much time will be required for complete eradication.

PEARS

TRANSPORTATION

Important tangible results of the investigations on the precooling and refrigeration of pears in transit from the Pacific Northwest have recently become apparent in the reductions in transportation and refrigeration charges granted by the railroads. The demonstration that precooled pears could be shipped as satisfactorily in a 720-box carload as in the customary 520-box load was the basis for a reduction of 14 cents a box in the cost of freight and transit refrigeration, a potential saving of over $500,000 annually to the northwestern pear industry.

PROTECTION AGAINST FREEZING

In the investigation of methods of protecting fruit shipments from damage by freezing during transcontinental shipment in severe weather a new method has been developed which promises to be more effective and more economical than those previously employed. When consignments are forwarded under "shipper's protective service" the risk of loss from freezing damage is assumed by the shipper, who generally endeavors to provide against it by adding extra insulation around the load. This method is commonly used with northwestern pears, particularly because of the danger of causing the pears to become overripe in transit if artificial heat is applied to protect them from freezing. In transportation tests conducted during the past winter it was found that the latent heat of fusion of water could be employed to protect the pears from freezing in transit. Sawdust saturated with water was packed under the lower portion of the load, and the heat liberated when this water was frozen in transit protected the fruit from freezing for 2 days longer than the use of dry straw and building paper as customarily employed by pear shippers. These tests were conducted during very severe winter weather with temperatures as low as −38° F. The wet sawdust method not only was found to be more efficient but to cost from $10 to $12 less per car than the customary practice. These results, if confirmed by further investigations, will be of great value to the northwestern pear industry.

STORAGE, HANDLING, AND UTILIZATION OF KIEFFER PEARS

Studies on the storage and ripening of Kieffer pears have resulted in the important discovery that this variety can be ripened to acceptable quality for dessert or canning purposes at a temperature of 60° to 65° F. As ordinarily found on the market or utilized it is characterized by a gritty and tough texture and poor quality generally. The importance of proper ripening temperature for Kieffer pears has not heretofore been known. In this study it was found that when temperatures higher than 65° were employed for ripening, the grittiness and toughness of texture became progressively worse, whereas at 65° the fruit could be ripened with a quality approaching that of the Bartlett. It was found that the pears could be held for periods of 60 to 90 days at 32° and then ripened with good quality at 60° to 65°. This ripening temperature was more important than picking date or maturity at time of harvest on ultimate eating quality. In canning tests of the fruit stored at different temperatures ranging from 32° to 100° the quality and characteristics of the raw material were evident in the canned product. Fruit ripened at a temperature of 60° to 65°, at which it developed a quality not ordinarily recognized as possible for this variety, yielded a canned product that was very acceptable in quality. At higher temperatures the quality of the product was markedly inferior. These results should be of great value to the growers of Kieffer pears and to the eastern pear-canning industry, since in the East the Kieffer comprises a large proportion of the pears grown.

STRAWBERRIES

The Blakemore strawberry, the first selection to be named and introduced as a result of the Bureau's strawberry-breeding work, is being extended commercially. It is known to succeed as far south as southern Georgia, southwestern Texas, and southern California. Especially good reports have come during the past year from Arkansas, southern Missouri, western Kentucky, southern Illinois, southwestern Michigan, and western New York south of Buffalo. Although

caught by a severe frost in the spring of 1932 in North Carolina, it survived the summer conditions better than the older standard sorts. In 1933 it was more than a week earlier than the older standard sorts and ripened most of its crop while the prices were highest. It also produced a much heavier crop than the older sorts.

The Bellmar, Southland, and Redheart varieties, more recently introduced, are proving very promising in the respective regions for which they are intended. The Bellmar has proved particularly hardy in Minnesota. For preservation by freezing, the Redheart has held its quality the best out of some 300 to 400 different lots tested. In the Northwest the Redheart is showing particularly well, not only as a canning berry but also for freezing. The Southland is of interest for home gardens and local markets in the South.

Three additional selections, introduced in 1932, have been named Dorsett, Fairfax, and Narcissa. They were selected because of their productiveness and superior quality. The Dorsett and Fairfax are recommended for trial in the Eastern States and the Narcissa in the Northwest. In 1933 all three showed up exceptionally well both in the field and on the market.

About 30,000 new strawberry seedlings fruited in 1933 at the United States Plant Field Station near Glenndale, Md., about 6,000 fruited at the North Carolina Coastal Plain Branch Station at Willard, and about 10,000 at the Oregon Agricultural Experiment Station, Corvallis. Many of these seedlings represent the accumulative results of earlier breeding work, with one or both of the parents superior selections from earlier work. A large number of exceptionally choice selections may be expected to come from this collection. In addition about 2,000 selections made from earlier developed seedlings are being further tested to make a more complete determination of their merits.

FROZEN-PACK INVESTIGATIONS

In the investigations of the frozen-pack method of preserving fruits it has been definitely proved that very rapid freezing as employed in the "quick freezing" methods is not only unnecessary but is sometimes detrimental to quality. With fruits packed in small retail containers it has been found that the best quality in most cases, as well as the greatest economy in cost, is attained by freezing at a temperature of 10° to 15° F. When the fruit is packed in barrels, however, a temperature of about zero was found desirable on account of the larger mass and the necessity of its being completely frozen before deterioration sets in. These results definitely dispel the current idea that expensive special equipment for very rapid freezing is essential in the use of this method of preservation and indicate that the facilities available in practically every cold-storage plant can be satisfactorily utilized. The limitations of this method are to be found in problems of distribution and marketing rather than in the use of particular methods of freezing. Studies during the year have further confirmed the results of earlier work, indicating that an airtight container is essential for the satisfactory preservation of certain frozen-pack fruits.

These investigations have also emphasized the great difference that exists in different varieties of fruits with respect to their suitability for preservation by freezing. This varietal difference is very pronounced in peaches. While some of the standard commercial varieties of strawberries yield a fairly good frozen pack, the studies have shown that several of the new strawberry selections developed by the Bureau are superior for preservation by freezing to any existing named variety thus far tried.

Extensive investigations have been in progress with respect to the bacterial and other microorganism content of fruits and vegetables preserved by frozen pack. It has been demonstrated that hermetically sealed containers are superior to nonairtight containers, the destruction of microorganisms, other things being equal, being more pronounced in the former. The difference is most noticeable when storage is at from 15° to 20° F. Since the spoilage of foodstuffs is largely due to microbial activity, it is believed that these findings must inevitably result in more intelligent practices in the frozen-pack industry and among food handlers generally.

CARBON DIOXIDE IN STORAGE OF FRUITS AND VEGETABLES

In the investigation of gas storage of fruits, it was found that soft scald and soggy breakdown of apples can be prevented by treatment with carbon dioxide for 2 or 3 days prior to cold storage at 32° F. Such treatment, in an atmosphere of about 45 percent carbon dioxide, was found to be just about as effective in preventing these storage diseases as employing a continuous temperature of 36°

during the storage period, while at the same time the apples were preserved in much better general condition. Moreover, the gas treatment does not disrupt the ordinary methods of operating a cold-storage plant as would be necessary if a special temperature were required for varieties particularly subject to these diseases. The gas treatment was also just as effective as immediate storage at 32°, which under practical operating conditions is frequently impossible to provide, with consequent heavy losses from soft scald and soggy breakdown.

In other experiments it was found that the quality of peas, baby lima beans, and sweet corn, which deteriorate so rapidly after harvest owing to loss or conversion of sugar, can be satisfactorily maintained for several days by storage in carbon dioxide gas. This discovery promises to be of great importance to shippers and canners by suggesting methods of insuring better quality when shipments must be made to distant markets or when the products cannot be canned promptly after harvest.

NUTS

PECANS

Investigations show that pecan foliage must be retained on the tree until late fall if well-filled pecans and annual bearing are to be secured. A loss of leaf area caused by diseases or insects results in poorly filled nuts one year and very light or no blossoming the following year. About six compound leaves per nut are required to produce a large well-filled nut and provide for sufficient storage of food reserves for blossoming the next year. Where the foliage was reduced to four leaves per nut the kernels were light, with considerable air space between kernels and shell, although the flavor was fairly good. However, the production of flowers and the set of nuts the following year was considerably reduced, as compared with a greater quantity of foliage to nuts.

Orchard practices that result in excellent growth and healthy foliage have been shown to increase the percentage of the total crop grading in the larger sizes and also the degree of filling of the nuts. Tree growth in most parts of the pecan belt can be stimulated by the use of fertilizers high in nitrogen. In many sections foliage can be maintained in healthy condition only by an extensive and thorough spray program.

PERSIAN WALNUTS

The practicability of artificially cross-pollinating certain varieties of Persian walnuts in California has been demonstrated on a commercial scale, as a result of extensive studies in pollination and in the blooming habits of the varieties. The necessity for cross-pollination in some varieties is not because of self-incompatibility, but because the staminate and pistillate blossoms of the individual varieties do not reach maturity simultaneously. Artificial cross-pollination has apparently increased the acre yield in one orchard from about 140 pounds to more than 3,000 pounds, at a cost of only about $3 per acre. In some of the artificially cross-pollinated orchards the yield was sufficient to produce a profit for the first time in the history of the orchards. Similar results can be obtained only when the varieties in the orchard are such that pollen is not available when the pistillate blossoms have developed.

VEGETABLES

BEANS

A promising new mosaic-resistant early bean of the Refugee type, resulting from the Bureau's breeding work, is of special interest to canners and seedsmen. It is about 2 weeks earlier than the Refugee Green variety, and a canning test shows it to be well suited for canning. It is a selection from the tenth generation of certain hybrid lines. Its earliness is of importance because the present commercial strains are so late that in many of the important bean-seed-growing districts frost comes before the seed is mature, and the result is a widely fluctuating and erratic supply of seed. This new bean will not only go far to stabilize and insure a supply of seed but will also tend to provide a regular and dependable supply of raw material for canning. Although it shows a considerable degree of resistance to mosaic, it is not immune to that disease.

CABBAGE

In some of the extensive cabbage-growing districts a disease known as yellows has been very destructive. Through breeding and selection, varieties of the more important cabbage types have been developed that are highly resistant to this disease. Comparative trials with commercial lots of disease-resistant varieties were made. In general, with the exception of Wisconsin Hollander, these

showed low percentages of yellows where nonresistant varieties were 100 percent diseased. This unsatisfactory condition of Wisconsin Hollander is now being corrected by the development of new resistant lines. The development of yellows-resistant cabbage selections in the breeding work represents strikingly the application of the principles of genetics in the working out of a practical problem.

LETTUCE AND MUSKMELONS

Many thousands of carloads of lettuce and muskmelons are grown and shipped annually from the Imperial Valley in southern California and from other points in California and the Southwest. Some years ago the lettuce industry was seriously threatened with extinction because of disease in the growing plants. The muskmelon growers have been suffering heavy losses each year from destructive diseases.

Intensive breeding and selection work has been in progress for several years, and strains of lettuce have been developed which have undoubtedly saved the lettuce industry of this area. While the selections already made are reasonably satisfactory, the work is being continued with a view to developing still better varieties. Some notable progress was made during the past year in the improvement of both lettuce and muskmelon selections.

The new lettuce Imperial No. 13, introduced early in 1932, has been proved in commercial tests to be an outstanding variety in quality and yields for the important midwinter crop in the Imperial Valley. It is also fully resistant to brown blight. Another lettuce (no. 152), not yet released, in preliminary trial plots has given promise of producing sure crops of high quality in the Imperial Valley in December and early January, when yields and quality are uncertain, as well as having a place in other sections at other periods.

Under a joint project with the California Agricultural Experiment Station a muskmelon (no. 50-15) resistant to powdery mildew has been developed and introduced. It gives indications of going far to overcome a serious handicap on the Imperial Valley muskmelon industry by reduced quality and yields as a result of the mildew.

PEANUT SEED STOCKS

In cooperation with the Virginia Agricultural Experiment Station, seven stocks of Virginia-type peanuts have been developed which grade 85 percent or more of the extra-large size. These improved stocks are all consistently higher yielders than stocks now in use. It is expected that seed will be released to the trade at the end of the 1933 season. These stocks are of particular economic importance not only because of their high yielding capacity but because of their high grade and high market quality. A substantial premium is usually obtained on large-size peanuts. Even at present low prices, fair yields of these stocks will materially increase the grower's margin of profit.

PEAS

There is prevailing among the growers of peas for canning an impression that the application of potash fertilizers to the soil has a deleterious effect on the quality of the peas. It has been shown by chemical study of different grades of peas harvested at different stages of maturity in several different seasons that muriate of potash and superphosphate produced no effects of practical importance on rate of development or composition of the peas. Readily available nitrogen, however, was shown to have a pronounced effect on composition even in instances when yield was not affected. An abundant supply of nitrogen results in a higher sugar and lower starch content and a smaller proportion of protein to total nitrogen. These differences are characteristic of peas in the younger stages of maturity. These results with nitrogen are of particular interest in view of the fact that it has previously been shown that there is a significant relationship between an abundant supply of nitrogen and yield. This study demonstrates that adequate nitrogen may not only increase yield but also improve quality.

POTATOES

EFFECT OF CAREFUL HANDLING IN CONNECTION WITH HARVESTING

In cooperative investigations at the Colorado Agricultural Experiment Station at Greeley a comparison was made of the extent of bruising injury resulting from different methods of handling potatoes in connection with harvesting, and some rather unexpected but significant and far-reaching results were obtained. Different lots of tubers were carefully dug by hand, and in contrast, by the elevator type of potato digger. One portion of the tubers of each lot was carefully picked

up, placed in trays, and stored without further handling. Similar lots were picked into wire baskets, dumped into sacks, and stored; while others lots were picked in bushel baskets and hauled to the storage house and dumped in a bin. Observations indicated that much of the injury in harvesting was directly attributable to the dumping of the tubers into sacks and to abrasions of the skin due to rubbing one against another in the burlap bags. Inspection of the tubers early in February showed that tubers dumped into sacks were spongy, while those handled in baskets or trays were firm and showed little injury.

BREEDING INVESTIGATIONS

The merits of the new Katahdin variety, a selection resulting from the Bureau's potato-breeding work and introduced to the trade about 2 years ago, have been still further emphasized in commercial tests, even though it is not a variety that can be recommended for planting in all sections. Two other highly promising selections—the Chippewa and the Golden—are now being introduced. The Golden is a yellow-fleshed variety which represents a new type of potato so far as the North American trade is concerned, although a number of yellow-fleshed importations from South America have been made. These two new varieties in experimental plantings have proved to be highly resistant to a number of serious diseases besides possessing high quality.

In the continuation of the potato-breeding work advantage is taken of the improvement already developed in selecting parents for crossing, and besides these selections many of the recently introduced varieties, mostly from South America, including certain wild or primitive types, are being used. It is expected that some of these new introductions and some of the primitive types will transmit disease resistance to the progeny. Many thousands of seedlings from hand-made crosses are now under test either directly by the Bureau or through the cooperation of State experiment stations. Several hundred selections from earlier breeding work are also under test for the purpose of still further determining their merit.

SWEETPOTATOES

For a number of years sweetpotato seedlings obtained through cooperation with the Virgin Islands Agricultural Experiment Station and a few introductions made directly by the Bureau have been under test to determine their merits in comparison with standard varieties in the trade, and also their disease resistance. From these seedlings and introductions there have been made a small number of selections which appear particularly promising. Tested in 1932 under severe stem-rot conditions in Virginia and in Kansas, some of these selections showed practically complete immunity to this disease. Two in particular not only appeared to be practically immune to stem rot but gave evidence of having market qualities equal to any varieties at present in the trade, and they appear to have good culinary quality.

TOMATOES

A most important and practicable method of preventing the spread of bacterial canker by tomato seed has been demonstrated. Seed extracted from the pulp by the fermentation method transmits practically none of the disease. In a field test plants grown from unfermented seed showed 15 percent infected with canker, plants from seed fermented 24 hours produced 0.87 percent infection, while plants grown from seed extracted from pulp fermented 48 hours or longer were disease-free. These results have been corroborated by two seasons' work. The effect of fermentation on the organism causing bacterial canker is still further demonstrated in a striking way by the results of infection experiments made with fermented and unfermented juice of diseased fruits. Inoculations with unfermented juice produced 100 percent infection; juice fermented 24 hours gave 15 percent infection, and that fermented 48 hours resulted in no infection whatever. It has also been found that in some sections, at least, the organism causing bacterial canker of tomatoes does not persist in the soil to any considerable extent longer than 2 years. A small infection has occurred where tomatoes were planted on infested soil in the second year after the soil became inoculated, but a negligible degree of infection occurred the third year. It would appear, therefore, that if disease-free seed is used, and proper seed-bed sanitation measures are employed, a 3-year rotation should enable tomato growers to avoid damage by bacterial canker.

VEGETABLE STANDARDIZATION

The standardization studies of vegetable varieties take into account the fact that most vegetables are propagated from seed and that different growers selecting seed of a variety inevitably develop types that differ from one another in form, size, quality, productiveness, and in other respects. This inevitably results in confusion, in difficulties in establishing grade standards, in the proper conception of what the accepted type of a variety is, and in other ways. The object of the standardization work is to develop a widely accepted standard of type for each important commercial variety, and to promulgate such type standards with a view to eliminating types that for any reason are undesirable or inferior to the best of the variety.

Through widely cooperative efforts, the standardization studies have been completed on cabbage, pea, and tomato varieties, and a well-illustrated publication on each of these vegetables is in press. Similar studies on the standardization of onion, carrot, beet, and spinach varieties are in progress. Other vegetables will be taken up in turn as rapidly as conditions permit. It is confidently believed that the results of this standardization work will represent large economic savings to the growers as well as to the processors and the consumers.

QUALITY OF CANNED VEGETABLES DEPENDENT ON CHARACTER OF RAW VEGETABLES

In vegetable-utilization investigations it has been found that in many instances the variety used is a highly important factor in determining the quality of the canned product. This is especially true of pumpkins and peas. Certain varieties of pumpkin make a superior canned product, while others are inferior. Although the quality of canned peas depends to a considerable extent on the variety, it has been found possible to make satisfactory canned products from a great many varieties provided they are harvested at the proper stage of maturity, which, however, varies with the variety. For instance, the Alaska, one of the leading canning peas, should be canned at an earlier stage of maturity than the Thomas Laxton.

The stage of development at which the material is used is a factor second in importance only to the variety in determining quality in canned products. In asparagus the chemical composition, food value, and canning behavior of the shoots vary continuously from tip to base of the shoot. The protein content is highest at the tip and lowest at the base. Total solids are highest at the tip and base, and lowest at an intermediate point. Sugars are highest at the base and titratable acidity highest at the tip. These chemical differences are correlated with the increase in palatability and desirable flavor which occurs in asparagus in passing from the base toward the tip. In rhubarb there are progressive changes in composition with increase in age of petioles which result in wide differences in palatability, food value, canning quality, and reaction of the product with the metal of the container. There is consequently a definite range of age of the petioles within which they may be canned with satisfactory results. The successive crops of petioles produced throughout the season are equally valuable for cooking or canning if used at a like stage of development.

CEREALS

BARLEY

Atlas barley, a selection of the Coast type produced in cooperative experiments at the California Agricultural Experiment Station, is increasing rapidly in acreage. It now occupies some 40 percent of the barley acreage harvested for grain in that State.

An analysis of 5 years' yield results from the entire United States and Canada shows that the Trebi variety, introduced by the Department, has a remarkable range of adaptation. This variety was the highest yielder at 31 stations, no other variety leading at more than four points. Trebi is not considered satisfactory for malting, but is a high-grade feeding barley.

A widespread and previously undescribed loose smut of barley, *Ustilago nigra*, which may be controlled by ordinary seed treatments, has been discovered. It has heretofore been confused with the ordinary loose smut, *U. nuda*, which can be controlled by hot-water treatments only. The new smut is controlled by the usual treatments for either loose or covered smut. It can be identified by the blacker color of its spores.

CORN

BREEDING

A method of breeding in which superior inbred lines are used as pollen parents in crosses with a commercial variety has been tested for a number of years at Sacaton, Ariz. Inbred lines extracted from Sacaton June, an improved variety of Laguna corn, have been crossed with the parent variety and the yields compared. Certain crosses have consistently outyielded the parent variety.

In uniform tests in Virginia, Illinois, Indiana, Ohio, and Iowa a few hybrids have stood out as among the best at all locations, indicating that some hybrids may have a very wide adaptation.

Chromosome studies, which have assumed great importance in plant-breeding investigations, are being conducted with hybrids between maize and perennial teosinte. The possibility of plant improvement by increasing the number of chromosomes can be tested very directly with this material. Strains closely resembling maize, yet having twice the number of chromosomes normal to maize, have been isolated from teosinte-maize hybrids.

Seed of parent lines of four corn hybrids, developed in cooperation with the Iowa station, was placed with farmers in 1933 for production on a commercial scale. In 1932 these hybrids produced yields 14 percent greater than the average of open-pollinated varieties in the Iowa corn yield test and were markedly more resistant to lodging and otherwise more valuable.

A high-yielding hybrid, developed in cooperation with the Indiana station, is being distributed in that State for additional testing and to produce seed in anticipation of commercial-scale introduction.

A variety of pop corn developed in cooperation with the Kansas station has been placed with experimenters in 36 States for trial and production. This variety has yielded well and has a high popping expansion and good quality. It has a comparatively wide adaptation for a corn variety and may be expected to mature properly in the Corn Belt south of latitude 42° and also in western Oregon and Washington.

BACTERIAL WILT

During 1930 and 1931 bacterial wilt of corn was unusually severe in many localities, and in 1932 it reached a degree of severity and extent of distribution in the Northern States that probably has not been equaled since Stewart published his original account of the disease 35 years ago. In Pennsylvania, for example, losses of 65 to 90 percent on early varieties of sweet corn were noted in certain localities. In New York the disease was very severe, reaching 40- to 60-percent infection on Long Island. In Illinois losses varied from 90 percent in the early market varieties to 30 percent in the later canning varieties. Associated with the great severity of the disease in these States was its unusual northward extension. It was found doing commercial damage in Connecticut and in Massachusetts, even in the northern tier of counties. In Michigan it was widespread, occurring as far north as Oceana County on the west and Alpena County on the eastern side of the Lower Peninsula.

Golden Cross Bantam, the hybrid sweet corn developed cooperatively with the Indiana station, in 1932 proved its continued resistance to bacterial wilt. This variety has been introduced commercially and is much in demand by canners and market gardeners. While highly resistant, it is not immune and needs to be improved upon.

In 1932 there was an epidemic of bacterial wilt on the leaves of dent corn throughout the Corn Belt. Losses of leaf area ranged from traces to 50 percent, and there was a distinct shrinkage in yields and lowering of quality. Plants severely attacked by bacterial wilt also were abnormally susceptible to Diplodia stalk rot and to injury from chilling and freezing.

GRAIN SORGHUMS AND BROOMCORN

Wheatland and Beaver milos, short erect-growing varieties bred especially for combine harvesting, were grown on some 100,000 and 75,000 acres, respectively, in 1932. These varieties are particularly useful in the wheat-producing areas of the south-central Great Plains, since they can be grown and harvested with the same machinery as wheat.

Atlas sorgo, produced in cooperative experiments at the Kansas station, was grown on some 150,000 acres in 1932. It is popular because it is less subject to lodging than other sorgos and because the seed is suitable for the same uses as grain.

A strain of Dwarf milo has been isolated which is proving highly resistant to the serious milo disease occurring in southwestern Kansas and northwestern Texas.

OATS

Adapted cereal varieties are necessary for proper diversification of agriculture in the South. Crown rust in oats seriously limits the production of winter oats in that area. Bond, Victoria, Alber, and Berger oats, recently introduced by the Department from Australia and South America, are highly resistant to this disease. Bond, Alber, and Berger show indications of being adapted to different sections of the South. Very promising hybrids involving the above varieties are being developed.

RICE

Rexoro rice, produced in cooperative experiments at the Louisiana station, is meeting with general favor as a high-quality crop. In 1932 some 20,000 acres were grown. In late November of 1932 this rice sold at a premium of from 50 to 60 cents a barrel over other long- and medium-grain varieties.

SEED FLAX

Studies of flax varieties grown at widely distributed points show that the larger-seeded varieties such as Bison and Rio yield a high percentage of oil, but the drying quality is distinctly lower than that of oils obtained from the small-seeded varieties, Linota and Redwing. Bison, otherwise very superior in yield and disease resistance, is inferior in oil-drying quality. Drought or abnormally high temperature during seed development results in lower yield, lower percentage of oil, and lower oil-drying quality.

Browning (*Polyspora lini*), a disease new to the principal seed-flax areas of the United States, was found in North Dakota in 1932. Bison, highly resistant to flax wilt, is very susceptible to the browning disease. Other commercial varieties appear to be quite resistant to it. Periods of low temperature during both spring and fall seem to be favorable for the spread of this disease.

WHEAT

IMPROVED VARIETIES

Extensive abandonment of winter wheat sown in the fall of 1932 (32 percent of the entire acreage) emphasizes the importance of developing more hardy winter varieties. The new variety Yogo, produced in experiments cooperative with the Montana station, is unusually winter hardy, resistant to bunt, and well adapted and high yielding in the northern winter-wheat sections of the Great Plains.

The bunt-resistant varieties Ridit and Albit, produced in cooperative experiments at the Washington station, were grown on some 750,000 acres in 1932. These varieties have done much to reduce losses from bunt in an area where control formerly seemed impossible.

SELENIUM INJURY

The grain of wheat plants grown in soil to which selenium has been added causes pathological symptoms and death in rats, similar to the symptoms produced by grain from certain areas. It is concluded that the presence of selenium in the soil and its absorption by plants are responsible for livestock poisoning in these localities. In sand and solution cultures containing selenium, the addition of sulphur checks characteristic symptoms of selenium injury in the plants. The value of sulphur is being tested in the field.

BARBERRY ERADICATION

Progress continues in reduction of losses due to black stem rust of wheat, oats, barley, and rye, by removing common barberry, the spring host plant for the rust fungus. This control measure, carried on since 1918 by the Department in cooperation with the States of Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin, and Wyoming, has resulted in the destruction of more than 18,600,000 rust-spreading barberry bushes, sprouting bushes, and seedlings. Rust damage to wheat in these 13 States has in the meantime decreased from an average annual

loss of approximately 57,000,000 bushels during the 5-year period 1916–20 to an average annual loss of less than 8,000,000 bushels of wheat during the last 7 years, and the loss in 1932 is estimated at 2,749,000 bushels. This steady reduction in damage has taken place in spite of the fact that in some of the later years weather conditions were extremely favorable for the rapid spread of the disease. The marked decrease in rust damage as the number of barberries eradicated has increased indicates that the eradication campaign is proving to be an important factor in the economics of small-grain production. It is desirable that remaining bushes be removed as rapidly as possible, not only to reduce the sources of rust inoculum but to prevent reseeding to barberries of territory already cleared during the eradication campaign of the last 15 years.

FORAGE CROPS

ALFALFA

In the study of bacterial wilt of alfalfa the results indicate that the correct approach to a solution of this trouble is being taken. Selection from descendants of certain highly resistant alfalfa plants increased resistance from 2 to 30 times over its frequency in the original stock. With this evidence, the study of control can go forward with greater confidence in the methods adopted.

SWEETCLOVER

Sweetclover is an excellent forage and soil-improving crop, long known to be of value in the Corn Belt, and has been found to be valuable in the drier portions of the West. New methods of seeding have had to be studied, and this has been done at some of the Bureau's dry-land field stations in the Great Plains in cooperation with State stations. It was shown that a good stand was almost certain to result when sweetclover is seeded by drilling early in the spring on Sudan grass or sorghum stubble. A new crop rotation has been built up around this fact. New varieties, such as Madrid yellow and Redfield yellow, introduced by the Department, have proved of value in the Great Plains and together with improved cultural methods have stimulated interest in this crop.

CROTALARIA

The use of crotalaria for soil improvement, especially in orchards of the tung-oil tree and in Gulf States citrus orchards on sandy land, has greatly increased, owing to the fact that crotalaria is not infected by the root-knot nematode. This fact is of large importance for any soil-improving crop to be used on sandy land in the South as far north as the peach area of North Carolina. *Crotalaria spectabilis*, a species introduced by the Department, is preferred, as its short blooming period and later maturity make it less attractive to the stink bug. It has also been shown that this species may be a useful soil-improving crop as far north as the Ohio River wherever the type of farming allows the use of a summer soil-improving crop. Other species have proved to be good forage crops.

WINTER LEGUMES

Winter legumes continue to be of vital importance in the South for preventing soil erosion and improving crop yields. In cooperation with the Georgia Coastal Plain Experiment Station it has been shown that, over a period of 8 years, the use of winter legumes has increased the average acre yield of seed cotton by 300 pounds and the average yield of corn by 10 bushels. The chief winter legumes used are Austrian winter peas and vetches, but these crops differ in value in different sections, and a part of the work in which the Bureau is engaged consists in testing various species and varieties of vetch to determine the value of each under varying soil, climatic, and cultural conditions.

LESPEDEZA

Notwithstanding the importance of liming soil and of the lime-loving legumes such as alfalfa and clover, there is need of legumes that will thrive on acid soils without the addition of lime. The Bureau has therefore been pressing the study of vetches, crotalarias, and lespedezas for the benefit of those large areas where acid soils prevail and liming is not economically feasible.

Korean lespedeza, introduced by the Department in 1921, has now spread from the Atlantic coast to eastern Kansas, and in Missouri it has reached such importance that new rotations are being built around it with the object of reducing the

acreage in corn. The value of the seed crop alone in 1932 is estimated to have been double the annual appropriation for the forage-crop work of the Bureau of Plant Industry. *Lespedeza sericea*, a perennial species lately introduced by the Department, has not yet been sufficiently tested, but already has given promise of great usefulness on the worn, acid soils everywhere south of the Ohio River and east of Kansas.

TIMOTHY

While the demand for timothy hay in city markets has declined, timothy is still one of the important forage crops, occupying in 1929 some 7,600,000 acres of clear timothy and 15,600,000 acres with clover. There are many areas in the United States so much better suited to timothy than to any other forage crop that, even though the city market is lost, timothy still remains an important farm crop. The effort of the Bureau has been directed, therefore, to developing varieties best suited to farm use, and methods of seeding, culture, and harvesting that will result in the best timothy forage for cattle. The time of harvesting timothy hay has been found to be an important factor in quality. When cut early, timothy is a good feed for dairy cattle, being high in protein and in vitamin G. In 12 days after the time when the plants began to head, there was a decrease of 60 percent in the vitamin G content. This doubtless explains the value of timothy for grazing.

PASTURE INVESTIGATIONS

The pasture studies carried on in cooperation with the Bureau of Animal Industry and the Bureau of Dairy Industry and with several State stations have reached a point where some important facts have been developed.

USE OF FERTILIZERS

In Pennsylvania the proper fertilizing of mixed grass pastures has resulted in a production of two and one half times as much milk per acre as on comparable pastures not fertilized, and the cost of the milk produced during the 4-month grazing period, due account having been taken of all expenses, was 25 percent less on the fertilized than on the nonfertilized pastures.

In West Virginia the fertilized pastures produced more than double the quantity of milk produced on the pasture not fertilized. At this station also it was found that the kind of fertilizer to use must depend on the local soil deficiencies. Lime and phosphate increased the yield of grass by 26 percent but the milk flow by only 4 percent, while lime, phosphate, and potash increased the yield of grass by 80 percent and the milk flow by 68 percent.

Where a complete fertilizer is used, grazing can begin 2 weeks earlier than where no fertilizer is used. The same principle applies to the renovation of old pastures. In New England, fertilizing an old pasture resulted in three times as much grazing as was secured from a comparable nonfertilized pasture.

In fertilizer experiments in cooperation with the Bureau of Dairy Industry the use of large quantities of nitrogenous fertilizers resulted in an increase of 45 percent in the amount of digestible nutrients in the grasses, but whether the application of such large quantities of nitrogen is profitable has not yet been determined.

It has long been known that fertilizers will affect the chemical composition of some plants, and the work at Beltsville, Md., has shown clearly that not only the quantity but the quality of pasture grasses is influenced by the fertilizers used. The application of nitrogen increases the protein in grasses, the application of phosphorus the phosphates, and the application of lime the calcium.

SYSTEMS OF PASTURE MANAGEMENT

At Beltsville, Md., and at the Sni-a-Bar ranch in Missouri, the continuously grazed pastures have so far given better results than those alternately grazed. There may, however, prove to be an adverse effect on the grass cover of the continuously grazed pastures; but since these experiments must be discontinued, it will not be possible to determine this point.

The advantage of rotating the cattle to a field of supplementary pasture during the summer was well shown at Sni-a-Bar ranch, where cattle moved to Korean lespedeza for 6 weeks in midsummer gained 125 pounds per head, as against 113 pounds for those continuously on bluegrass. The lespedeza also made a good seed crop.

EMERGENCY PASTURES

Work at Augusta, Mich., on emergency pastures of Sudan grass or Sudan grass and soybeans has brought out the great value of using such pastures instead of depending on the ordinary grass pasture during the summer. In general there is enough grass in early spring. The important problem is to develop a system of continuous good grazing throughout the summer. The crops to be used will vary in different sections.

At this station, too, the use of alfalfa for grazing has been carefully studied, and returns from grazed alfalfa have been compared with those from alfalfa cut for hay. During 1932, dairy cattle continuously grazed on alfalfa returned the farmer $36.49 an acre, while alfalfa hay at prevailing prices returned $18.30 an acre, or only about half as much as from pasture. Obviously with better prices for hay the difference would be less, but even so, the balance is so decidedly in favor of the pasturage that the difference would still be significant. Grazed with sheep, the alfalfa returned $10 an acre, as against $3 an acre from grass pastures.

REESTABLISHING NATIVE SOD

In a study of methods for reestablishing the native sod in central Kansas it has been shown that buffalo grass can be established readily by planting pieces of sod at intervals of 3 to 6 feet, and that a good stand can be secured even when the plant fragments are scattered on prepared land by means of a manure spreader. Buffalo grass is, on the whole, the best permanent grass for this district, and the demonstration that this grass can be established vegetatively at relatively low cost should prove of value.

FIBER PLANTS

COTTON

COMMUNITY PRODUCTION IN THE EASTERN COTTON BELT

The production of cotton fiber of uniform quality is the objective of improvement measures, both of breeding and of cultural procedures. With every improvement in length or strength of staple, there is greater need of uniformity of the fiber to meet the mill requirements. The lack of sufficient quantities of uniform cotton has been recognized as a serious limitation of the textile industry. Hence, special attention is being given to methods of production and handling that will enable manufacturers to obtain commercial quantities of uniform cotton. The planting of only one variety in each district is a fundamental step which is necessary if the production of a regular quality of fiber is to be sustained.

With the general recognition of the danger that had resulted from the production of excess quantities of inferior fiber, active interest in measures of improvement found expression, particularly during the last 2 years, through the American Cotton Cooperative Association, the State colleges, experiment stations, and extension services of the cotton-growing States, with the result that single-variety improvement organizations have been established in numerous communities in several States. Though many of these communities are still in the early stages of development, several outstanding examples of the advantages obtainable under the community plan are to be found, notably in North Carolina, South Carolina, Georgia, Alabama, Mississippi, Texas, and Oklahoma. Several of the communities in these States have developed to the point of establishing a commercial production of uniform fiber, with definite arrangements for maintaining their stocks of pure seed. Precautions of isolation and roguing of seed-increase fields and separate ginning of the community cotton are being observed.

IMPROVED VARIETIES

Breeding and selection work with Acala cotton are being continued in order to maintain the uniformity and productiveness of the variety. The present seed stock has a higher percentage of lint than any other variety with staple of equal length. Since the acre yield of seed cotton has been maintained during the period of selection, the increased percentage represents a distinct gain in acre yield of lint. The improved seed stocks of this variety pass immediately into commercial production on hundreds of thousands of acres in the single-variety communities in California, Arizona, New Mexico, Texas, and Oklahoma.

Breeding work with other promising varieties is being continued, and many tests are being made in different districts to determine any special advantages of other varieties over Acala either in yield or in staple length. Test plantings of

sea-island and Egyptian cotton are being made at several places in southern California outside of the usual cotton zones in order to investigate the possibilities of acclimatization to special conditions where the production of extra staples from perennial plants may be possible.

Substantial progress has been made in developing Sakel × Pima 30 cotton, the new variety obtained by crossing Pima, the only variety of Egyptian-type cotton now commercially grown in the United States, and Sakel, the most valuable of the varieties grown in Egypt. In comparative yield tests in 1932 of Sakel × Pima and Pima cottons, conducted at the United States field stations at Shafter, Calif., and Sacaton, Ariz., the yield of lint of the new variety surpassed that of Pima 43 percent at Sacaton and 21 percent at Shafter. These results, considered in relation to those obtained in previous years, indicate that, under diverse conditions of climate and soil, the new variety may be depended upon to outyield Pima at least 20 percent. The lint from these plantings has been placed in the hands of several of the largest American consumers of imported Sakel cotton, who have undertaken spinning tests to determine its value in comparison with the Sakel cotton grown in Egypt. If the results of these tests are satisfactory, a good demand for the new cotton is to be expected.

ROOT ROT

Further information has been obtained regarding the habits of the root-rot fungus, following the discovery of the sclerotia or hold-over bodies, announced in 1929. At first it was very difficult to find the sclerotia in the soil, on account of their small size and irregular occurrence, but with greater experience special methods have been developed for tracing the distribution of the sclerotia at different depths or in relation to remains of plants that the fungus has destroyed. From such studies it was learned that sclerotia are not formed abundantly where an active growth of the fungus is taking place, nor adjacent to taproots of plants recently killed, but farther out in the soil, often several inches away from the roots. Sclerotia are found far below the plow sole, and deep-seated infestations of the fungus continue for periods of several years on buried tree roots, even where no cotton or other susceptible crops are grown or where clean fallows are maintained. Also the fungus may hold over in fallow lands by forming large strands with layers of thick-walled cells surrounding a central core which apparently remains viable for long periods, like the sclerotia.

Methods of applying soil disinfectants are being developed for eradicating small centers of infection of the root-rot fungus or for placing barriers against its spread to valuable trees or to particular areas not yet occupied by it. Ammonia water and formaldehyde solutions are being employed, and further experiments are being made to determine the relative values of different applications, taking account of the direct effects of the disinfectant on the fungus and the after effects on the soil as shown in the crops of the following seasons.

FIBER FLAX

Fiber flax has been grown with varying results on several different types of soil in the Willamette Valley in Oregon, but there has been a lack of definite information as to the adaptability of the crop to the different soils. Cooperative tests with 105 growers of fiber flax, comprising 750 acres and nine different soil types, were conducted in 1932. Seven different fertilizer treatments were given. Accurate records were kept of the height of the plants and of the yields of straw, fiber, and seed. Spinning tests were made of fiber from the two leading soil types, Chehalis and Amity. Under the climatic conditions in 1932, with temperature slightly above normal and rainfalls slightly below normal during the flax-growing season (April to June), the best results were obtained from the Chehalis soils.

A recent experiment demonstrates that flax fiber superior to the imported can be produced in this country. A small scutching mill, 14 by 36 feet, equipped with two cement retting tanks with the temperature and flow of water under control, and with deseeding, breaking, and scutching machinery, was built at the fiber flax station at Corvallis, Oreg., and first used in preparing the fiber of the experimental plots of 1932. Fiber from pedigreed varieties grown in the experimental plots and retted and scutched in this mill was hackled in a commercial spinning mill. It hackled 73.2 to 76.5 percent, as compared with about 65 percent for good Belgian flax and 50 to 55 percent for Russian.

ABACA

In cooperation with the Fiber Standardization Board in Manila and the American cordage manufacturers, the cumbersome and unsatisfactory system of grading abaca fiber has been entirely reorganized. The number of recognized official grades of this fiber has been reduced from 21 to 11, that of the waste products from 11 to 3, and the standards of machine-cleaned fiber have been modified. These changes will greatly simplify the work of the inspection service and should result in more uniform and reliable standards of quality of both fiber and cordage.

SUGAR PLANTS

SUGAR BEETS

DISEASE-RESISTANT VARIETIES

Strains of sugar beets resistant to the serious leaf-spot disease have been found and brought to stabilized condition by inbreeding. Hybrids produced by intercrossing these strains exceed in both tonnage and sucrose percentage the performance of commercial strains and show decisive superiority under leaf-spot conditions. The introduction of leaf-spot-resistant sugar beets for general use is now definitely forecast and for large areas in the Middle West will provide a measure of relief against a disease that has in many seasons made crop production and factory operation unprofitable.

The curly-top-resistant variety U.S. No. 1, which has proved to be superior in years when the curly-top disease is important, was also found to compare favorably with the best commercial varieties in years when curly top is unimportant. It produced a slightly lower tonnage but equaled commercial strains in quality. The benefits in curly-top years should greatly outweigh the tonnage reduction in noncurly-top years. Seed production on a commercial scale was definitely reached in July 1933, when the crop from 470 acres in New Mexico, Utah, and California was harvested. This seed, produced under the supervision of this Bureau by interested sugar-beet companies, will be sufficient to plant 35,000 acres in 1934 and will be used in the severely affected curly-top acreas. Possibility of markedly increasing seed yields by heavy applications of nitrogenous fertilizers has been shown.

CULTURAL EXPERIMENTS

Cooperative tests carried on with the Bureau of Agricultural Engineering have demonstrated that sugar beets can be efficiently blocked mechanically by using a suitably equipped cultivator run at right angle to the row. These tests, confirming commercial experience, have furnished an answer to the question as to the effect such mechanical handling of the crop has upon yield. The yields obtained with mechanical blocking, where the stand was adequate and soil condition good, are at least equal if not superior to those obtained with the much more laborious method of hand blocking. Because of increased efficiency that resulted, 30 to 40 percent of the labor cost of thinning beets was saved. The method is now in wide practical use in Colorado, Nebraska, Minnesota, North Dakota, and Iowa, and is being adopted in other areas.

Experimental studies with sugar beets in storage piles have definitely shown that beets from fields deficient in phosphoric acid show greater loss from rotting than the beets from strips in the field fertilized with phosphoric-acid fertilizers. This discovery opens up a benefit derivable from fertilizer applications which was entirely unsuspected and one that is of great importance to the industry.

Experiments in many sugar-beet-growing areas have shown decided trend toward increased yield and quality of sugar beets as the space allotment per individual plant is reduced from the rather wide spacings commonly employed. With rows 20 inches wide, close spacing in the row, such as 8 or 10 inches, when contrasted with wider spacings, gave significant increase in yield and very frequently in sucrose percentage. While the weight of the individual beet apparently is slightly reduced as beets are grown closer in the row, the greatly increased numbers of beets per acre more than compensate for the slight reduction in size.

Experiments with sugar beets grown under irrigation have shown that present practices in utilizing irrigation water can be improved. Irrigation early in the season showed superiority over the common practice of delaying irrigation of young sugar beets 2 or more weeks in the spring, since a setback in the spring apparently is very tardily overcome. Late application of water increased tonnage appreciably, and where sufficient time was allowed to elapse before harvest, sucrose percentage of the sugar beets was not decreased.

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Evidence has been obtained that the chief function of cultivation with the sugar-beet crop, as has been shown for certain other crops, is weed control. A few shallow cultivations have been found preferable to the common practice of deep stirring continued late in the season. In experiments where sugar beets were cultivated both lengthwise and across the rows, gains have been obtained only in cases where weeds were an important factor.

SUGARCANE

ADAPTATION OF VARIETIES TO SOIL TYPES

Intensive tests on the adaptation of the sugarcane varieties now commercially grown in Louisiana to the representative soil types in the sugar belt have been reported during the year. These tests, located on uniform areas of the desired soil types, as determined by a previously conducted reconnaissance and soil survey involving determination of soil reaction (pH), have made it possible to definitely recommend particular varieties for the principal soil types.

Sharkey clay constitutes nearly 30 percent of the cultivable area in the sugarcane belt of Louisiana. Much of it is considered unprofitable to use except in times of high prices for sugar. Studies prove that injury by root diseases is responsible for unsatisfactory yields on these lands. By a program combining the use of organic materials available on all plantations as a soil amendment, and the use of C.P. 807 or similar cane varieties introduced by the Bureau, this large proportion of the cane belt may be utilized successfully for cane culture even under the present condition of low prices.

IMPROVED DISEASE-RESISTANT VARIETIES

Gratifying progress has been made in breeding disease-resisting varieties of sugarcane adapted to the soil and climatic conditions that exist in the Louisiana sugarcane belt. Two seedlings, C.P. 28/11 and C.P. 28/19, have shown considerable promise. In limited tests they have given evidence of possessing the quality of early maturity, comparing favorably with that of P.O.J. 234, which has heretofore been outstanding in this respect among the commercial varieties. The two seedlings have given evidence of superior vigor and better stubbling qualities as compared with P.O.J. 234.

Careful large-scale tests of sugarcane varieties imported by the Bureau have indicated definite superiority of Co. 290 over varieties previously imported and released for commercial culture. Co. 290, while rather late in maturing and not immune to the virus disease mosaic, ranks high in production of sugar per acre. On the basis of these tests a gradual change in varieties, illustrated by the crowding out of P.O.J. 213 and P.O.J. 234 by Co. 290, C.P. 807, and Co. 281, is definitely forecast.

A definite and rapid shift to the disease-resisting varieties of sugarcane imported or bred by the Bureau has taken place in the sirup belt extending from Florida to Texas, and restoration of yields to former levels, and in some instances to higher levels, has resulted. In particular, the Department seedling C.P. 807, which is apparently immune to mosaic, has made a remarkable showing in sirup production. The average sirup yields of this variety at the field station near Cairo, Ga., have been over 500 gallons per acre for both plant cane and first stubble.

Further studies of Co. 281 have proved that, in comparison with other varieties grown commercially, it possesses outstanding resistance to deterioration when windrowed, a characteristic permitting utilization of this variety for protecting a portion of the crop against freeze injury and indicating the possibility of profitably extending the grinding period.

STORAGE

About 900,000 tons of the sugarcane produced in the United States is temporarily stored in factory piles or otherwise during the grinding campaign, and 5 percent or more of the sugar is lost by respiration and other physiological processes. By an inexpensive method of sprinkling the cane to control humidity in the piles, devised in cooperation with the Bureau of Chemistry and Soils, nearly 90 percent of this loss can be avoided. Because of the loss in stored mill cane, which was suspected but not accurately calculated before this investigation by the Department, it was considered unwise to lay up a large supply of cane in the mill yard. The advantage of assembling a supply of cane sufficient to operate the mill for several days is that interruption of the milling process due to bad weather and the resulting impossible harvesting conditions is thus avoided. Interrupted milling is very costly and has long been recognized as a large factor in increasing the cost of sugar fabrication. The improved method of storage

can be profitably utilized to reduce the number of mill shutdowns and in some cases to avoid them entirely.

TOBACCO

CULTURAL EXPERIMENTS

NITROGEN NUTRITION

An extensive agronomic and physiologic study of the effects of the nitrogen supply on the nutrition of tobacco shows that the amount of available nitrogen has marked effects on the morphology of the plant, the internal processes of nutrition, and the composition of the leaf, and is one of the principal factors determining the type as well as the grade or quality of the cured product. A relatively high nitrogen supply produced a large, broad, thin leaf which cured with a clear brown color, effects that probably are connected with the high water content maintained in the leaf throughout its period of growth. The combustibility of the leaf was lowered, and the content of nicotine and other nitrogenous constituents was materially increased while the carbohydrate content was reduced. The content of oxidizing enzymes, which have an important effect on the fermentation process, was materially increased. A very low nitrogen supply produced a small, narrow, thick leaf which cured with an uneven red color mottled with yellow and a dull luster. A moderate supply of nitrogen produced the maximum rate of growth and earliest maturity. For the cigarette grades of leaf 30 to 40 pounds of fertilizer nitrogen per acre gave best results, while the indicated nitrogen requirements for cigar leaf are decidedly higher. Under the conditions of the tests ammonia and nitrate forms of nitrogen were equally effective provided calcium and magnesium were included in the fertilizer mixture. The Mitscherlich equation did not satisfactorily fit the yield data for the various rates of nitrogen fertilization.

SULPHUR AS A FERTILIZER

Although the sulphur requirements of tobacco are not large, tests have shown that the light sandy and sandy loam tobacco soils frequently fail to supply a sufficient quantity of this element for the crop, especially in seasons of limited rainfall and during the early stages of growth. Apparently a more liberal rainfall will very nearly supply the small additional quantity of sulphur required. It is desirable that adequate provision for available sulphur be made in the fertilizer treatment, but, on the other hand, an excess may injure the quality of the tobacco, especially in the bright cigarette types of leaf. The effects of variation in the sulphur supply are somewhat similar to those produced by differences in the supply of nitrogen, and apparently the sulphur (SO_3) requirements are about equal to or somewhat less than the nitrogen requirements. Sulphur deficiency produces a pale light-green color in the plant as a whole and retards growth; an excess produces a dark-green color in the plant, delays ripening of the leaf, and interferes with satisfactory curing.

DISEASES

DOWNY MILDEW

In laboratory studies of the downy mildew or blue-mold disease it has been found that spore germination and infection can occur over a wide range of temperature. Spore production and the growth of the fungus through the tissues of the host plant, however, are both sharply limited by moderately high temperatures. Spore production is favored by night temperatures between 50° and 65° F., with the optimum around 60° to 62°, and such temperature conditions are essential to the development of this disease in epidemic form. In experiments conducted in the greenhouse and plant bed in the spring of 1933 the disease was effectively controlled by maintaining night temperatures above 70°. It is believed that in most localities the critical period over which such temperature control would be needed would not exceed 3 weeks.

WILDFIRE

Reports that *Bacterium tabacum*, the cause of tobacco wildfire disease, would infect many plants in addition to tobacco have led to the discovery that this bacterium secretes a very powerful toxin which produces the large yellow halo spots characteristic of this disease by destroying the leaf chloroplasts. Merely pricking leaves with a solution of this toxin in complete absence of the bacteria was sufficient to produce typical lesions on the leaves of many species of plants, some being much more severely affected than tobacco. However, it was found that the bacteria themselves were unable to live for any length of time or to multiply in tissues of plants other than tobacco or susceptible species of *Nicotiana*,

and in the field these were the only plants that became diseased. Hence it was concluded that despite the wide range of plants susceptible to the action of *Bact. tabacum* toxin only species of *Nicotiana* should be regarded as true host plants.

ROOT KNOT

Most of the soils cropped to tobacco in the South Atlantic States are more or less infested with the nematode or root-knot disease. In addition to destroying completely many fields of tobacco each year, the yield and quality of the crop is seriously reduced over much larger areas, but in such an insidious manner that the damage is overlooked by the average grower. The extreme susceptibility of tobacco to root-knot disease may be judged by the fact that soils considered as only moderately infested, and which give good yields of susceptible crops such as cotton or sweetpotatoes, are often a complete failure when planted to tobacco. The problem of finding crops that can be safely used in rotation with tobacco is most difficult because such resistant ones as corn and Iron cowpeas may carry over sufficient nematode infections as to make tobacco culture unprofitable. So far the only plants found effective in controlling root knot when used in a 3-year rotation with tobacco are peanuts and native weeds. The work of testing a large number of plants to find additional crops that can be safely used in rotation with tobacco is being actively pushed and a large number are under test. However, even after a number of suitably resistant crops have been found the problem will not be solved from the practical viewpoint until methods have been developed whereby nematode control and the production of high-quality tobacco are combined.

HOPS

Encouraging progress has been made in the control of the downy mildew of hops that invaded the Oregon and Washington hop fields in 1930. This disease has caused heavy losses to hop growers and threatens to eliminate the crop completely in those States unless its ravages and spread are controlled promptly. This problem has been attacked along two lines: (1) Control of the disease in the field through spraying, treatment of the crown with fungicide dusts, and clean cultural practices, and (2) development of resistant varieties through selection and breeding. The first method is of immediate benefit in that it enables growers to continue the present varieties with only moderate losses, thus in a large measure preventing a shortage of hops at this time when there is a greatly increased demand for this commodity. The second method requires considerable time, but the results already obtained point to the possibility that eventually more resistant varieties may be introduced to reduce losses further and to lower production costs. Hop varieties from several European countries have been introduced during the year for use in breeding disease-resistant types. In turn, European breeders have been supplied with American varieties for similar use. The work is being carried out jointly by the Bureau and the Oregon Agricultural Experiment Station.

FOREST-TREE DISEASES

NEW DISEASE OF BEECH

A beech disease caused by the action of a species of the fungus *Nectria* in association with an insect, the felted beech coccus, has appeared in this country. The origin of the *Nectria* is uncertain, but the insect is European. The disease was first observed in North America in Halifax, Nova Scotia, in 1914, and by now it has killed 35 to 40 percent of the beeches in that Province. The disease has spread over New Brunswick and now is known to occur at several places in Maine. The insect has been reported also from New Hampshire and Massachusetts. It is not unlikely that the beech may go the way of the chestnut.

The fungus seems to enter the tree through the multitude of punctures made by the insect. The tree dies and the fungus fruits, producing myriads of tiny red fruiting bodies over the surface of the dead bark. From these, when mature, are extruded the spores, which spread the infection to such other beeches as are already attacked by the insect.

The beech is a valuable forest tree in the Eastern States and also in the South, though less abundant in the latter region. Maine has the largest stand, but as much of it is inaccessible, Pennsylvania maintains the largest cut. The beech has great recreational value, not only in the forests but also as a park and street tree.

A NEW NEEDLE BLIGHT OF COLORADO FIR

The white or Colorado fir (*Abies concolor*) is grown extensively in the northeastern part of the United States as a shade tree and is an important forest tree in the West. Two years ago a large planting of these trees at the Matthews

Arboretum, Hamilton, Mass., was found to be attacked by a disease that killed back the needles of the new growth. From a distance the trees appeared as though injured by late frosts, and the young needles were affected before they reached maturity. The disease was found to be due to a fungus not previously reported in North America. It was known to cause injury to various firs in Europe and particularly in Scotland. In the latter country silver firs (*A. alba*) were most seriously attacked, but the American noble fir (*A. nobilis*), an important forest tree, was also susceptible. Since the first discovery of the disease at Hamilton it has been found also in Augusta, Maine, and at Lake George, N.Y. The origin of the disease in the United States has not yet been determined. The trees affected are, for the most part, old well-established trees, and no recently imported trees from affected areas have been planted in these localities.

DISEASES OF CONIFEROUS NURSERY STOCK

The value of the sulphuric-acid and aluminum-sulphate soil treatments in forest nurseries, developed in earlier experiments on the control of diseases of coniferous nursery stock, has been further confirmed for the western and central parts of the country by continued experience. Control of weeds as well as disease prevention is obtained by the treatments. Recent laboratory tests have shown that the effect of the treatments on disease is due to the change that they induce in the active acidity of the soil solution.

DUTCH ELM DISEASE

Recently a serious outbreak of the Dutch elm disease has developed near Newark, N.J., involving more than 300[1] trees scattered over some 600 square miles and other infections have been found on Staten Island and Long Island, N.Y. Situated in the heart of the region in which the especially susceptible American elm is native, this infection demands energetic action or this European disease may destroy this important American tree. A control program in cooperation with the State of New Jersey is being undertaken and as rapidly as possible this work will be extended to other States in which infection is found. But 1 additional tree affected with this disease was found during the year in Ohio, in which State 8 infected trees were destroyed in 1930 and 1931.

The recent interception by quarantine officers of importations of burl elm logs infected with the Dutch elm disease and infested with its European insect vectors indicates that such logs are a probable means of transfer of the disease from Europe to North America.

WHITE PINE BLISTER RUST

During 1932 good progress was made throughout the several white pine regions of the country in the development and application of measures for the control of the white pine blister rust. The blister rust is of foreign origin, having been brought into North America about 30 years ago, and is now widespread. This fungous disease is recognized as the most destructive enemy of the white pines in this country, and its successful control means the protection of forest crops having a merchantable value of more than $415,000,000. These species also have high scenic value, as they occur naturally in the forests and on the many parks and recreational areas. In some localities the white pines planted as ornamentals have values which in the aggregate exceed the forest values of these species. Practical methods have been worked out by the Bureau of Plant Industry for the control of the blister rust in each of the important white pine regions, and under the leadership of the Bureau this protection work is being carried out cooperatively on the valuable Federal, State, and private pinelands concerned. Further improvements in methods are being developed from year to year as the work progresses.

PREVENTION OF STAIN, MOLD, AND DECAY IN LOGS AND LUMBER

During the past 2 years over 200 pine and hardwood mills in the United States, Canada, Mexico, and the Philippine Islands have adopted the inexpensive organic-mercury treatment developed by the Bureau for the control of stain and mold in pine and hardwood lumber. By far the largest field of use is in the Gulf States, where, owing to high temperatures and humidities favorable to fungus development, heavy losses were suffered annually through inability to control stain and mold. The lumbermen's newly acquired ability to produce high-quality lumber free from such fungous discolorations has resulted in the recent adoption of higher standards in lumber grades. Not only has the domestic trade been given higher

[1] Including 100 found since the close of the fiscal year.

quality lumber, but the more discriminating export trade has been kept satisfied in its demands for better-appearing lumber and timbers. Recent commercial tests have confirmed the laboratory discovery of effectiveness for certain new chlorinated-phenolate treatments, which, though costing little more, appear still more effective on certain species, particularly pine, and are under less suspicion of danger to workmen in handling the preservative.

Although these dipping treatments already are widely adopted, a potentially greater expansion lies in the field of the so-called "small mill." It is the consensus of opinion that the small portable mill, cutting on small tracts of second-growth timber, will within the next decade largely supplant the large mill. Since second-growth pine contains a large proportion of susceptible sapwood, and since immediate kiln-drying is not a likely prospect for most small mills, the need for cheap and effective dipping treatments at these mills has been particularly acute.

In addition to their use on lumber and timbers, these treatments have been found effective in preventing deterioration of hardwood logs during the winter banking season, and of possible value as pretreatments for protecting sap-gum ties, pine poles, and piling from stain and decay infection during the normal air-seasoning period prior to final pressure treatment.

DRY-LAND AND IRRIGATION AGRICULTURE

DRY-LAND FARMING

The soils of the Great Plains are naturally rich in the elements of fertility. Continuous cropping for 25 years or more has not reduced this fertility sufficiently to be reflected in the yields of grain, and attempts to increase the fertility of the soil or its productiveness by turning under green-manure crops or by applying barnyard manure or commercial fertilizers have had no significant effects on crop yields. The production of crops in normal years is more or less determined by the extent to which the cultural methods increase or conserve the soil moisture for crop use. Experimentation has led to cheaper and more rapid methods of seed-bed preparation that maintain or increase production and overcome to a large extent wind and water erosion of the soil and the loss of water by run-off.

A series of experiments on the treatment and care of deciduous-tree shelter belts at Mandan, N.Dak., for 15 years has shown that clean cultivation with no pruning or very moderate pruning provides the most favorable condition for tree growth and survival. Severe pruning with clean cultivation, and straw mulching with no pruning, are most unfavorable to growth and survival. Entire neglect of cultivation is inferior to the practice of clean cultivation, but it is preferable to the use of a straw or hay mulch.

Experiments conducted for 11 years at Akron, Colo., in cooperation with the Colorado Agricultural Experiment Station have shown that sheep can be used on the dry-land farm to reduce materially the cultivations necessary in the culture of grain crops without a corresponding reduction in yields. This lowers the cost of production and increases the labor income. The pasturage afforded by stubbles, weeds, straw, and cornstalks in a 4-year rotation of fallow, winter wheat, corn, and barley amounted to more than half the carrying capacity of native sod. Such by-products are best utilized in connection with a unit of native sod pasture. The length of the pasture season and the gains of the sheep per acre are much less closely controlled by the quantity of the seasonal or the annual precipitation on such a combination of native sod and by products of cultivation than they are on the native sod alone.

LAND RECLAMATION AND QUALITY OF WATER

Definite progress has been made in solving the problems that are encountered in reclaiming and bringing into a high state of productivity the more refractory soil types characteristic of large areas in the irrigated West. As a result of investigations extending over a period of 25 years a practical solution has been found for the more acute problems in connection with subjugating the hard-land areas, which are often highly impregnated with alkali. The more important features contributing to subduing successfully such soils are: (1) Where necessary, a lowered water table; (2) properly leveled land, in order that water penetration may be adequate; (3) the addition of humus to the soil in the form of stable manure and the growing and plowing under of green-manure crops, such as sweetclover; and (4) the manner of treating the soil itself, i.e., in certain instances avoiding plowing and substituting the disk and spring-tooth harrow. In general the usefulness of the foregoing treatments have been recognized for some years, but the possibilities of their combined intensive application have but recently been determined.

Where the irrigation water is pure, crop plants are rarely injured if adequate subsoil drainage is provided. However, throughout the West many large irrigation water supplies are carrying substantial quantities of so-called alkali salts, some as high as 1 ton per acre-foot of water. These dissolved salts are not evaporated nor appreciably taken up by plants, but remain in the residual soil solution unless drainage is provided and precautions taken to leach the root zone periodically so that approximately as much of the dissolved salts are removed as are brought in by the irrigation water. Unless such protective measures are taken, it is inevitable that eventually the land will become worthless for agricultural purposes. Irrigationists who advocate the economical use of water are now more generally recognizing that their recommendations must not be followed too literally if continued high productivity is to be assured.

Investigations relative to the quality of the irrigation water have resulted in developing an entirely new and highly important perspective with reference to avoiding the excessive accumulation of salts in the soil brought in by irrigation waters. This has been made possible by measuring the volume and salinity of the irrigation water delivered to an irrigated area and determining the volume and salinity of the drainage water removed from it. From these measurements it is only a matter of arithmetic to ascertain whether the salt balance is favorable or adverse. In many irrigated areas it is not unusual to divert 3 to 4 acre-feet of water annually for each acre of irrigated land. Hence it is evident that the drainage system for such lands must be so designed and operated as to remove substantially as much salt as is brought in by the irrigation water.

As an outgrowth of these investigations, analytical data have been assembled recently regarding the quality of several thousand samples of irrigation water. From these data it is now possible to draw significant conclusions with respect to such features as (1) the present conditions within the areas as influenced by the character and concentration of the salinity in the irrigation supplies; (2) the sources of salinity contamination; and (3) the extent that dissolved salts are moving into and from the irrigated lands. These investigations are clearly of vital importance to the continuing success of the areas involved.

BORON

Definite progress has been made in solving the more acute boron problems confronting farmers and orchardists. As the salts of boron are found in injurious concentrations in many irrigation water supplies in the Southwest, particularly in California, and as this element is highly toxic in relatively small amounts to many crop plants, a practical solution of the problem is of immediate and vital importance. The investigation has been pursued along two major lines: (1) By extensive surveys and comprehensive analyses of water supplies in the areas where boron injury is suspected; and (2) by determining the limit of tolerance of the more common crop plants. The investigation has been definitely productive of results of immediate application and points to an effective solution of the problem (1) by eliminating sources of boron contamination, (2) by blending various water supplies so as to diminish the boron concentration below the critical limit, and (3) by choosing crops of high boron tolerance.

SEED INVESTIGATIONS

SEED TESTING

During the fiscal year 22,828 samples of seed of agricultural crops were tested at the central laboratory in Washington, D.C., and at the four seed-testing laboratories maintained in cooperation with the States of Indiana, Missouri, California, and Oregon. The number included samples received from farmers, seedsmen, and others, as well as samples of imported seeds received through the United States customs service.

Seeds of the commercial bent grasses and redtop have been studied, with the result that seed of each kind now in the market is identifiable under usual circumstances, and the region of production usually is determinable.

Seed of the cultivated vetches has been studied with special reference to finding means by which the kinds may be distinguished by the seed alone. As a result of this study, it is now possible to distinguish the kinds now in cultivation, with the exception that the seed of the smooth form of *Vicia villosa* appears to be practically indistinguishable from the seed of the hairy form.

Seeds of the four kinds of lespedeza now in cultivation have been studied and can be identified. In following the behavior of the "hard seed" of lespedeza

from harvest to planting time, it has been found that (especially with Korean lespedeza) the high content of hard seed usual at harvest time decreases greatly by late winter or early spring.

Methods have been perfected for distinguishing in the seedling stages certain varieties of soybeans and rye that cannot be distinguished by the seeds.

Moisture tests of imported seeds of ryegrass, vetch, and fescue have shown that seeds of high moisture do not maintain their vitality well in transit and deteriorate rapidly in storage. A proper moisture content should be made one of the conditions in the purchase of imported seeds.

ENFORCEMENT OF THE FEDERAL SEED ACT

Owing to the low price of domestic seed and the relatively high tariff, the importation of certain seeds—alfalfa, alsike, red clover, and sweetclover—has continued at a very low ebb. In total, 11,551,400 pounds, or 643 lots of seed, were permitted entry under the Federal Seed Act, an increase over last year of a million pounds; but this increase occurred only in white clover, winter rape, and hairy vetch seed. All of the other seed imports permitted entry were decidedly less than last year. The total annual forage plant seed imports since 1931 have been approximately one third of the annual amounts for the 4-year period ended with 1930 and one fourth of the annual amounts for the 4-year period ended with 1926.

Approximately 72,000 pounds of forage-plant seed, mostly hairy vetch below the live pure seed requirements, was prohibited entry under the act. Most of it was exported. More than 3,000 pounds of rejected seed was destroyed, and a fine of over $400 was paid in the case of one lot of seed which had been prohibited entry and was put into consumption.

Investigation of alleged violations of the interstate section of the Federal Seed Act prohibiting the interstate shipment of misbranded seeds resulted in recommendations during the year for seizure of 19 lots of seed and for criminal action against nine shippers. Investigations pending in approximately 25 cases may result in criminal action against the shippers. The recommendations for seizure and for criminal action involved seeds of sorghum, soybeans, lima beans, rye, corn, red clover, alsike clover, orchard grass, and redtop misbranded as to pure seed content, freedom from weed seeds, variety, and live pure seed content.

PUBLICATIONS

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FRUITS

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Fruit-store puzzles: Tropical delicacies finding new friends. By T. R. Robinson. Bul. Pan. Amer. Union 67:101–108.

Deciduous-fruit improvement through tree-performance records. By A. D. Shamel and C. S. Pomeroy. U.S. Dept. Agr. Farmers' Bul. 1696.

Conditions resulting in increased drought injury and care of drought weakened trees. By E. C. Auchter. Va. State Hort. Soc. Proc. 37:205–212.

Drought injury—its occurrence and correction. By E. C. Auchter. Md. State Hort. Soc. Proc. 35: 102–108.

The care of drought weakened trees. By E. C. Auchter. Valley Fruit Grower 1(1):7, 18.

The importance of organic matter in orcharding. By E. C. Auchter. Kans. State Hort. Soc. Bien. Rpt. 41:52–55.

Meeting the needs of the tree economically. By F. P. Cullinan. Md. State Hort. Soc. Proc. 35:9–17.

The effect of water shortage on functioning of fruit trees. By J. R. Magness. Va. State Hort. Soc Proc. 37:200–204.

Irrigation of orchards by sprinkling. By F. L. Overley, C. P. Harley, E. L. Reeves, H. C. Diehl, and others. Wash. Agr. Expt. Sta. Bul. 268. (In cooperation.)

Bud selection studies. By A. D. Shamel. South. Florist 34(2):10–11, 15.

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Relation of leaf area and position to quality of fruit and to bud differentiation in apples. By M. H. Haller and J. R. Magness. U.S. Dept. Agr. Tech. Bul. 338.

Studies on the interrelation of leaf area, soil moisture, and nitrogen to fruit growth and fruit bud formation in the apple. By C. P. Harley and M. P. Masure. Wash. State Hort. Assoc. Proc. 28:212–216.

Further studies on the wax-like coating of apples. By K. S. Markley, S. B. Hendricks, and C. E. Sando. Jour. Biol. Chem. 98:103–107. (With Bur. Chem. and Soils.)

Progressive changes in the cuticle of apples during growth and storage. By K. S. Markley and C. E. Sando. Jour. Agr. Research 46:403–412. (With Bur. Chem. and Soils.)

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U.S. GOVERNMENT PRINTING OFFICE: 1933

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REPORT OF THE CHIEF OF THE BUREAU OF PLANT QUARANTINE, 1933

United States Department of Agriculture,
Bureau of Plant Quarantine,
Washington, D.C., August 26, 1933.

Sir: I transmit herewith a report of the work of the Bureau of Plant Quarantine for the fiscal year ended June 30, 1933.

Respectfully,

Lee A. Strong, *Chief of Bureau.*

Hon. Henry A. Wallace,
Secretary of Agriculture.

INTRODUCTION

The revocatior of two domestic plant quarantines, progress in the suppression of the pink bollworm in the United States, and the inauguration of a vigorous attack on a newly discovered gypsy-moth outbreak in Pennsylvania have been among the more important developments in plant-quarantine work during the fiscal year 1933.

The regulations that were canceled were those relating to the European corn borer and to the phony peach disease. The revocation of the corn-borer quarantine was made necessary by the lack of available funds for its adequate enforcement. In the case of the phony peach disease, on the other hand, the discovery that the disease occurred extensively in large peach-growing areas in a considerable number of States made it appear that further work in the direction of preventing the spread of this disease could be carried out more satisfactorily through the nursery-inspection organizations of the various States rather than under the provisions of a Federal quarantine. In the case of both the European corn borer and the phony peach disease projects, the Bureau is continuing to aid in prevention of spread by cooperating with the States in the inspection and certification of susceptible materials.

The Pennsylvania outbreak of the gypsy moth, which was found in the late summer of 1932, is the most extensive infestation of this pest that has ever been discovered in this country west of the New England States, with the exception of the one in New Jersey discovered in July 1920. The State and Federal Governments are cooperating in the effort to suppress the outbreak.

During the year the port inspection service made more than 20,000 interceptions of insects and plant diseases in shipments coming from foreign countries, including many serious pests of fruit, cotton, rice, beans, potatoes, forest trees, and other plants and crops of economic importance.

The progress of these lines of work, as well as the Bureau's activities in suppressing or preventing the spread of the Mexican fruit fly, the Japanese beetle, the pink bollworm of cotton, the Thurberia weevil, the Parlatoria scale on date palms, the brown-tail and satin moths, narcissus pests, the white pine blister rust, the black stem rust of grains, and the Woodgate rust, and preventing the introduction of foreign insect pests and plant diseases, are presented in detail in the following pages.

DOMESTIC PLANT QUARANTINES

GYPSY MOTH AND BROWN-TAIL MOTH

GYPSY MOTH FOUND IN PENNSYLVANIA

An infestation of the gypsy moth (*Porthetria dispar* L.) was discovered at Inkermann, near Pittston, Pa., late in July 1932. No special Federal or State funds were available to carry on clean-up work, but in the emergency the State made

arrangements to provide headquarters and storage, also to pay some miscellaneous items, and Federal funds, totaling $78,000, were drawn from the barrier-zone project to carry on the needed scouting and extermination activities.

A rapid survey made by four Federal experts in the fall of 1932 indicated that the heavily infested area included the city of Pittston, and extended north, east, and south. By the end of September, 48 additional men had been withdrawn from New England, and they continued work in Pennsylvania until early in November. Small infested centers were found in all directions, but there were fewer toward the west. This rough survey indicated that about 15 square miles could be considered heavily infested and that 95 square miles contained small local infestations. A surrounding area of an average width of about 3 miles was scouted roughly, particularly along the roads, to determine in a general way the limits of the area infested.

Later, the banks of the Susquehanna River to flood mark were scouted from Ransom to Nanticoke, and the Lackawanna River from its mouth to beyond the northern limits of the city of Scranton. This resulted in locating a number of dangerous infestations which were immediately treated. In addition to this, the area scouted embraced the entire cities of Scranton and Pittston and many small towns and villages, as well as the northern part of the city of Wilkes-Barre.

The funds available were not sufficient to determine the limits of infestation as it was necessary to concentrate most of the work in the heavily infested central district. The area so far found to be infested is 230 square miles.

The most urgent need was to reduce the infestation materially, particularly in the badly infested central area, before the larvae hatched in late April or early May, in order to prevent spread, and to do as much scouting and treatment as possible in the outlying areas.

The work has been carried on in cooperation with the State department of agriculture and the department of forests and waters. The Federal force supervised the work, furnished as many experts as possible, and supplied such spraying equipment, tools, insecticides, etc., as the funds available would permit. The State department of agriculture furnished labor and part of the supplies and also leased a building for office storage and headquarters for transport and spraying equipment in the city of Wilkes-Barre. An arrangement was made between the State department of agriculture and the State relief department to set up a fund of $100,000 to furnish work to the unemployed in the infested area. This arrangement was approved by the Governor, the funds were allotted equally to the relief boards of Luzerne and Lackawanna Counties, and a schedule set up so that men would be furnished regularly from the welfare lists.

Beginning January 16, 1933, and extending to June 30, the time was staggered so that each man who did satisfactory work would be employed for about 4 weeks. In all, nearly 1,000 men received work, an average of about 200 being employed throughout the period. They were engaged in cutting and burning worthless trees and brush in the badly infested areas. This work was closely supervised by Federal men detailed from the barrier-zone work, and gradually men from this welfare group were selected and trained to find and treat egg clusters, to climb trees, and to assist in spraying.

Since January 1933 there have been treated or destroyed over 1,850,000 gypsy-moth egg clusters, most of these being in the central infested area. An egg cluster contains an average of 400 eggs. Over 1,200 acres of wood and brush land were cut and the slash burned.

Spraying with arsenate of lead was begun in June and was not completed until July 7, 1933. Most of the 26 high-power spraying machines operated were used for treating small lots in cities and towns, and special care was necessary in order to prevent defacement of buildings and fences, and automobiles or other vehicles that were moving where the spray was being applied. Over 4,800 of such properties were treated in residential sections, and over 2,800 acres of woodland were also sprayed. In some of the latter areas conditions were such that the handling of hose lines was extremely difficult, and in one case 7,000 feet of hose had to be used in a single line in applying treatment.

There are only a few small nurseries in the infested area, and they do a local business. It was found, however, that there was some movement of native plants such as rhododendrons and laurel, and that some forest products and surface stones were moved out of the territory. It seemed necessary to safeguard the movement of such material in order to protect adjoining sections as well as other States, and that the movement of freight cars, particularly those stored on sidings which were bordered by infested trees, should be given attention. Accordingly a State quarantine covering the townships of Bear Creek, Exeter, Hanover, Jackson, Jenkins, Kingston, Plains, Plymouth, Pittston, Wilkes-Barre, and the

boroughs or other political subdivisions within or bounded by these townships or cities in Luzerne County, and the townships of Lackawanna, Ransom, Dunmore, Spring Brook, Jefferson, Roaring Spring, and Scranton, the city of Scranton, and any boroughs or political subdivisions within or bounded by these townships or cities in Lackawanna County, was announced March 15, 1933. Inspection of materials likely to carry infestation is required.

The principal materials inspected thus far have been props and lagging used in the mines, 6,721 units of this material having been inspected and certified up to the close of the fiscal year.

The results obtained in Pennsylvania have been most satisfactory considering the unusual difficulties which arose as a result of this emergency work. Although the area was scouted substantially as planned, the extreme limits of the infestation have not been determined up to the present time. A study of weather records which have been secured from the Scranton, Pa., station of the United States Weather Bureau covering the past 10 years, indicates that the trend of spread based on favorable wind and temperature conditions at the time when the wind spread of small larvae was possible, ranged from north to southeast from the central infested area. Unfavorable conditions for spread during this period in the sector northwest to south of the center was indicated. The actual spread that has been determined thus far has been principally in the directions indicated as favorable, but sufficient work has not been done to determine the outside limits of infestation. Intensive work is necessary on this project as this infestation is one of the largest and most difficult to handle that has been found outside New England.

CONDITION OF THE INFESTED AREAS IN NEW ENGLAND

Defoliation by the gypsy moth was more extensive during the summer of 1932 than during the previous year, the total area amounting to over 286,395 acres. The forests which were most completely stripped were those located south of Boston, in southeastern Maine, and in New Hampshire north and east of Lake Winnepesaukee. White pine suffered severely, particularly many of the smaller trees in Massachusetts, and the growth of deciduous trees was greatly retarded as is now shown by the subnormal length of twigs and branches.

Records received from owners of cranberry bogs in the territory south of Boston and on Cape Cod indicate a loss of 2,780 barrels of fruit for the year, and as severe defoliation injures the growth so as to prevent fruiting the following year, the entire loss for the 2 years will approximate $55,600.

BARRIER-ZONE PROJECT IN NEW ENGLAND AND NEW YORK

At the beginning of the fiscal year severe reduction in expenditures was made necessary by a 38 percent cut in the funds available for the gypsy-moth project. On this account it was necessary to curtail purchases of supplies and equipment to the minimum, and in addition to dismissing more than 90 regular salaried employees, it was necessary to furlough 69 others for 1 month in order to keep within the funds available.

Woodland scouting in the barrier zone, except in the area where the most infestations have been found, was abandoned; and during the latter part of July, on account of the finding of the serious infestation in northeastern Pennsylvania, the work in the barrier zone was further reduced by the diversion of $78,000 to provide for this unforeseen emergency.

As a result of such limited work as could be done in the barrier zone, 30 infestations were found—17 in towns in southwestern Massachusetts and 13 in northwestern Connecticut. Twenty-four of these were severe enough to require extensive spraying, and more than 1,900 acres were treated in this way during the month of June 1933. Weather conditions were excellent for spraying, and effective results have been secured in the areas treated.

In the New York section of the barrier zone extensive scouting has been done the by conservation department of that State. Two infestations were located, one at Dover and another at Milan. These were treated and thoroughly sprayed

In recent years, particularly in the spring of 1929 and 1930, rather conclusive evidence was secured that weather conditions were favorable for wind spread of the smaller caterpillars from territory east of the barrier zone to the section of the zone in southwestern Massachusetts and northwestern Connecticut. It is, therefore, of primary importance that more extensive work be done in this section of the zone, and that the woodland areas that have never been examined in Vermont and Connecticut be inspected at the earliest possible date.

Collections of over 400,000 female gypsy moth pupæ were secured near Middleboro, Mass., and from them over 166,000 females emerged. The tips of the abdomens of these insects were placed in a solvent and used in small cages for the purpose of attracting male moths. Two hundred and fifty moths were caught at 105 cages during the season, and some of these catches gave important clues as to the location of new infestations.

GYPSY MOTH WORK ON LONG ISLAND

The New York Conservation Department scouted selected areas in Queens County, North Hempstead and Oyster Bay towns in Nassau County, and Smithtown and Brook Haven towns in Suffolk County, Long Island. No infestation was found in Queens and Suffolk Counties. Twenty-three infestations were located in Nassau County, 13 of them being found in North Hempstead and 10 in Oyster Bay town. All these infestations were found in an area of approximately 2 miles in radius from North Roslyn. This area has been for several years under State quarantine, and all shipments proceeding from it are inspected and certified by Federal inspectors. During the year over 4,000 shipments, including nursery stock, forest products, etc., have been so certified. Two small infestations in Oyster Bay town were found about a mile north of this area. One of them was in a lumber yard and the other not far from a nursery establishment. Both of these locations have been placed under quarantine and in addition to the clean-up work that has been carried on in all the infestations mentioned, inspection and certification of products that are being moved has been required.

THE GYPSY MOTH IN NEW JERSEY

On February 6, 1933, a gypsy-moth egg cluster was found in the township of Randolph, N.J., near the Mendham-Randolph-Morris township lines. This is in the northernmost part of the area that had previously been found infested. Further scouting during the late winter and early spring resulted in the finding of 111 new egg clusters. These were treated, and arrangements were made to carry on spraying work in June. The location where these egg clusters were found was particularly difficult to examine carefully on account of the large number of ledges and boulders which cover most of the ground area and furnish convenient hiding places for the moths to oviposit. Owing to shortage of State funds and the need for prompt action, an arrangement was made whereby the Bureau furnished a supply of tanglefoot and arsenate of lead, together with a fully equipped high-power sprayer, for treating this infestation. The work was supervised and the labor supplied by the State department of agriculture. Sixty acres of woodland in and surrounding the infestation were thoroughly treated during the first half of June 1933.

On July 1, 1932, Federal work on the gypsy moth had been discontinued in New Jersey, but the State department of agriculture continued a limited amount of scouting and check-up work throughout the year. This project was supervised by a Federal expert who had been in charge of the work in New Jersey for many years and who was transferred to the State work with four other expert men at the beginning of the year. Over 1,900 cages used for attracting male moths were distributed in 51 townships in 6 New Jersey counties. These were located directly south and west of the area that had once been infested by this insect. No male moths were caught at any of these cages during the year.

EMERGENCY CONSERVATION WORK

For many years attention has been called to gypsy-moth infestations between the barrier zone and the Connecticut River, and their presence emphasized as a constant threat to success in maintaining the barrier zone.

In connection with the emergency conservation work which is being carried on throughout the United States, an arrangement has been made for the organization of a group of men in 10 camps of the Civilian Conservation Corps in the States of Vermont, Massachusetts, and Connecticut to carry on gypsy-moth scouting and clean-up work in this area. This work is in the formative stage, and it is hoped that with the completion of this organization early in the coming fiscal year it will be possible to find and treat the more heavily infested areas so that westward spread into the zone may be curtailed.

QUARANTINE AND INSPECTION WORK

During November and December the inspection of Christmas trees and greenery required the services of a number of agents who were transferred temporarily from the scouting force. As there were less calls for Christmas trees and greenery than in the past, there was a considerable falling off in such shipments particularly in carload lots of Christmas trees. During the spring and fall shipping seasons a considerable amount of nursery stock was moved, but in general orders were smaller than during the preceding year. There was a decrease in the number of carloads of nursery stock shipped, but in some cases the smaller units increased to a marked extent. Nurserymen reported that they were receiving about as many orders as formerly but these were smaller. Because of the volume of inspection it was necessary to transfer agents from the scouting force to assist the regular inspectors in the examination of nursery stock.

Tables 1 to 3 indicate the volume and kinds of products inspected and certified during the fiscal year.

TABLE 1.—*Evergreen products certified under gypsy-moth quarantine, fiscal year 1933*

Material	Bags	Bales	Boxes	Bundles	Carloads	Packages	Trees	Truck loads	Products found infested	Gypsy-moth egg clusters found
Balsam twigs	265	3	8	3		35				
Boughs		11,542	21		35	4				
Christmas trees					428		74,618		1 carload 1 truck load	3
Laurel	751	6,213	546	1,267		39		7		
Mixed greens	56	64	7,714	196		77			1 box	2
Miscellaneous		8	244	27		57		1		
Total	1,072	17,830	8,533	1,493	463	212	74,618	8	1 carload 1 truck load 1 box	5

TABLE 2.—*Forest products certified under gypsy-moth quarantine, fiscal year 1933*

Material	Bags	Barge loads	Boxes	Bundles	Carloads	Cases	Cords	Lots	Pieces	Truck loads	Products found infested	Gypsy moths found	
												Egg clusters	Larvae and pupae
Barrel parts				48	9	2			4	1			
Crates and cratings						13			86	1	1 piece	1	
Fuel wood	25		1	11	30		110	4		212	23 bags 1 box	36	
Logs					23				79	452	1 car	2	
Lumber	2	5		1	361			140		205	1 barge 10 cars 7 lots	117	7
Piles and poles		1		7	37				1,794	39	1 car	36	
Posts			1		10				437	6			
Pulpwood					957		9			2,070			
Reels					158			1	5,195	2	3 cars 9 pieces	28	
Shavings					34								
Ship knees									291				
Shrub and vine cuttings	1		107	247		9				3	1 box 1 bundle	2	1
Ties					616				12	16		[1] 14	
Miscellaneous	4		30	251	192	40	50	7	13,950	657	2 cars	98	
Total	32	6	139	565	2,427	64	169	152	21,848	3,664	[2]	334	[3] 8

[1] Egg clusters on car stakes.
[2] Infested total: 1 barge, 23 bags, 2 boxes, 1 bundle, 17 cars, 7 lots, 10 pieces.
[3] All larvae.

TABLE 3.—*Stone and quarry products certified under gypsy-moth quarantine, fiscal year 1933*

Material	Barge loads	Barrels	Boxes	Carloads	Crates	Pieces	Truck loads	Products found infested	Gypsy moths found	
									Egg clusters	Larvae and pupae
Crushed rock				725			1			
Curbing				113		1	12			
Feldspar				43						
Granite	136		360	2,684	840	83,977	232	7 cars 1 piece	[1] 36	[2] 4
Grout	28			80				4 cars	13	
Marble		8	12,912	1,220	23,998	3,074	2			
Paving	5		5	88				6 cars	15	1
Miscellaneous		5	152	4	4	17	23	1 truck	2	
Total	169	13	13,429	4,957	24,842	87,069	270	17 cars 1 piece 1 truck	66	5

[1] This does not include 212 egg clusters, 11 larvae, 47 pupae found on car stakes, blocking, and crating material.
[2] Includes 3 gypsy-moth pupae and 1 brown-tail larva.

Nursery stock certified under the gypsy-moth quarantine during the fiscal year consisted of 9,697 bales, 4,937 boxes, 124 carloads, 31,749 cases, 421 cash-and-carry packages, 9,370 packages, and 1,784 truck loads. Of these, 7 bales, 4 boxes, 10 cars, 6 cases, 1 package, and 3 truck loads were found infested with 39 gypsy-moth egg clusters, 8 gypsy-moth larvae, and 2 brown-tail winter webs.

Under a provision of the gypsy-moth-quarantine regulations, material which originates outside of the quarantined area may be shipped from points inside the area under permit. During the fiscal year nearly all types of products shipped under certificates were also shipped under permit. Permits were issued for the shipment of 4,332 individual or bulk lots.

Materials that have been manufactured, processed, or stored in such manner that, in the judgment of the inspector, no infestation could be transmitted, may be moved if accompanied by permits issued to the shipper. One hundred and three firms or individuals are now shipping under permit. During the fiscal year 8,159 individual or bulk lots were shipped.

During the time not required for regular inspection and certification work the inspectors have examined tourist camps for gypsy-moth or brown-tail moth infestation. The reports on this work cover 257 camps. Sixty-three camps were found infested with the gypsy moth to some extent, and three were also infested with the brown-tail moth. Eradication was recommended to owners. This has been done and the infestations destroyed.

VIOLATIONS

Investigations were made of 293 violations of the Federal and State gypsy-moth and brown-tail-moth quarantines, and of 52 reported violations of other quarantines effective in the New England territory. Most of these were non-commercial shipments, and about 80 percent were small shipments by mail. In no case was evidence secured of willful intent to evade quarantine requirements.

COOPERATION

As in the past, cordial cooperative relations have existed between the States concerned and the activities administered by the gypsy-moth project. The results secured during the present fiscal year have in a large measure been attributable to the interest and support of the States and the local officials with whom we maintain active cooperation.

THE BROWN-TAIL MOTH

The infestation of the brown-tail moth (*Nygmia phaeorrhoea* Don.) was more severe than during the previous season, especially in Maine and New Hampshire, and over 1,127,000 hibernating webs were cut and destroyed in New Hampshire and Massachusetts. No record is available of the webs that were cut in Maine.

There was a material spread of this insect beyond the quarantine line in Maine and New Hampshire, even reaching into five towns along the Connecticut River in Vermont.

THE SATIN MOTH

The satin moth (*Stilpnotia salicis* L.) was not so abundant during the summer of 1932 in the older infested areas as it had been during some of the previous seasons. However, severe defoliation of shade trees occurred in many places. Funds did not permit a thorough scouting of towns to determine the spread of this insect, and it was found in only two towns beyond the quarantined area. Fourteen violations of the satin-moth quarantine were reported and investigated during the year.

EUROPEAN CORN-BORER QUARANTINE AND CONTROL

GENERAL STATUS

Lack of adequate appropriated funds with which effectively to enforce the quarantine regulations on account of the European corn borer (*Pyrausta nubilalis* Hubn.) led to revocation of Notice of Quarantine No. 43, revised, on July 15, 1932. The Bureau's estimate for corn-borer quarantine and control during the 1933 fiscal year amounted to $795,000, or $155,000 less than the previous year's appropriation. As finally passed, the agricultural appropriation bill contained an item of $295,000 for maintenance of this work. It had been contemplated by the House Committee on Appropriations that the work could be continued with the reduced funds by eliminating road-patrol activities. Thorough consideration of the situation by Department officials indicated that the sum allotted was entirely inadequate to prevent movement via common carriers or motor vehicles of corn from infested to noninfested sections, and to carry out other protective measures which uninfested States might reasonably expect under a continuance of Federal quarantine. There remained no alternative but to revoke the quarantine and thus give uninfested States an opportunity to enforce such protective measures as they deemed necessary. Numerous quarantines paralleling the Federal regulations and restricting intrastate movement of affected products within infested States were also revoked following the Federal action.

In order that States outside the infested zone might have information upon which to base quarantine action, scouting operations along the periphery of the previously regulated territory were conducted as in former years.

Within a few days of the Department's announcement of the lifting of the Federal corn-borer quarantine, regulatory officials of four Corn Belt States met at Kansas City, Mo., for the purpose of considering uniform State quarantine action. State corn-borer quarantines and embargoes followed in quick succession after the Secretary's announcement of cancelation of the restrictions. A complete embargo on the movement of articles restricted in the revoked quarantine was issued by the State of Georgia coeffective with revocation of the Federal regulations. Louisiana followed on July 26 with a similar embargo, and during August, September, and October embargoes affecting the same articles were issued by Arizona, California, Nevada, Oregon, Utah, and Colorado. In November, Wyoming issued a still stricter embargo covering articles additional to those included in canceled Federal regulations. Indiana, as yet known to be infested only with the 1-generation strain of the borer, in May 1933 promulgated a quarantine against those States infested with the 2-generation strain of the insect.

Comparatively uniform restrictive quarantines were issued during July and August by the appropriate State officials of Illinois, Iowa, Kansas, Mississippi, Missouri, Nebraska, and Wisconsin. Similar action by South Carolina followed in October. Under these quarantines no distinction is made between the sections infested with the 2-generation strain and those infested with the 1-generation type of the insect. In addition, the restrictions in most cases apply to a class of articles exempt from the previously existing Federal regulations. These State quarantines admit certain quarantined products either when so manufactured or processed as to eliminate the corn borer or when inspected and certified by authorized State or Federal inspectors.

State quarantines under which State certification of restricted articles is acceptable and which contain special provisions not found in other quarantine groups were issued on various dates from July to October by Florida, Texas, Oklahoma, Kentucky, and Tennessee.

Each of the State embargoes or quarantine orders designates the following States as infested: Connecticut, Indiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont,

and West Virginia. In some instances Wisconsin is also mentioned among the States from which shipments are restricted, and the quarantines frequently apply to any additional States in which infestation may hereafter be found.

Regulatory action as a result of revocation of the Federal regulations has been taken by all uninfested States except Alabama, Delaware, Idaho, Minnesota, Montana, North Carolina, and North Dakota.

Extended conferences and correspondence with officials in States imposing embargoes finally resulted in agreement on the part of regulatory officials in Arizona, California, Colorado, Georgia, Louisiana, Nevada, Oregon, and Utah to accept Federal certification on quarantined articles shipped in accordance with the provisions of the Federal regulations in effect prior to July 15, 1932. Most of these agreements became effective in January 1933, with the revision of embargoes to provide for shipments into their respective States of quarantined articles from the infested zones when accompanied by Federal certification evidencing freedom from corn borer. Wyoming still retains its original embargo order.

Decision to inaugurate a Federal corn-borer inspection and certification service required a systematic survey of formerly quarantined territory to determine the amount of certification required and to acquaint dealers with the available service. The survey began in January and was concluded early in March. Territory in all States affected by the State requirements for Federal certification was divided into districts and various sections assigned to each of 23 men engaged in the survey. Although a complete survey was required of establishments shipping restricted articles, especial attention was first directed to large shippers of dahlia tubers, whose shipping season was near at hand. At the conclusion of the survey, the probable demands for Federal certification were summarized, and the surveyed territory was subdivided into areas which could be served conveniently by single inspectors. Territories as assigned early in March are as follows: Eastern Michigan, western Michigan, northern Indiana, southern Indiana and southwestern Ohio, northern Ohio, southeastern Ohio and West Virginia, western Pennsylvania, eastern Pennsylvania, New Jersey, southeastern New York and Fairfield County, Conn., western New York, northeastern New York, and the State of Connecticut other than Fairfield County. Inspection and certification in the New England States is furnished by inspectors working from the Boston and Springfield, Mass., field offices. In the 4 months that this inspection service has been available during the fiscal year, over 3,500 lots of quarantined articles were inspected and certified for movement to States accepting only Federal certification.

For the purpose of enforcing the Illinois quarantine, State authorities enlisted the cooperation of county police officials along the Illinois-Indiana State line from Lake Michigan to the Wabash River. These officials assisted in preventing the movement through their counties of uncertified quarantined material. Squads of Illinois highway police were also stationed for a time on roads leading into the State from Indiana. Truck loads of contraband material were turned back. Express shipments of produce moving contrary to the quarantine were confiscated. Three Illinois inspectors were stationed in Chicago to check, in compliance with the regulations, the receipt of quarantined articles in the market district. For a short period, three shifts of Michigan State inspectors were stationed at Benton Harbor, Mich., for the purpose of inspecting and certifying celery and other farm produce affected by the Illinois quarantine.

Enforcement of State regulations in general was largely secured through instructions issued by common carriers to their agents regarding acceptance of restricted material for movement into States quarantining against the infested States. Under the laws of many of the States, articles shipped contrary to regulatory orders are subject to confiscation when found within the State.

Recommendations issued in November by the joint committee on the European corn borer, a committee composed of representatives of each of five national professional societies, again recognized the value of the Federal quarantine in preventing long-distance spread of the pest.

SCOUTING AND NEWLY DISCOVERED CORN-BORER INFESTATIONS

Field inspections to determine spread of the borer in 1932 were completely organized by July 31. The 228 men comprising the 83 crews assigned to work in the western area were trained at 2 scout schools conducted at the Department-owned farm near Toledo, Ohio. The State of Illinois employed 16 of these scouts. The State of Wisconsin also furnished 2 crews of 3 men each. Sixty-six men were trained at a scout school held at Freehold, N.J. After

receiving instruction in their duties and examining infested cornfields in the vicinity of Freehold, these men were assigned to scout in sections outside the known infested districts of the Eastern States. Routine scouting activities in both the western and central areas were discontinued on September 13. A small amount of rechecking, rescouting, and river scouting was continued for a few weeks after that date.

Spread of the borer, as determined by scouting operations during the summer of 1932, was much less than the usual annual migration of the insect. Weather conditions in the spring and early summer largely unfavorable for flight of the adult moths evidently accounted for this less-than-normal spread. Newly infested townships were found in seven States. These new infestations are located within comparatively short distances of territory previously known to be infested.

Scouting in Mosel township, Sheboygan County, and Centerville township, Manitowoc County, Wis., in which townships a few borers were discovered in 1931 and where clean-up measures were subsequently practiced, gave negative results. Field surveys farther south in the lake counties of Wisconsin resulted in the collection of 13 borers on a farm in Mount Pleasant township, Racine County. This first-record find is the most remote from known infested territory of those discovered in 1932. Activities in Indiana resulted in the finding of small infestations of from 1 to 3 borers each in 7 townships of 5 counties in previously uninfested districts in the northwestern and southeastern sections of the State. The latter localities are all in close proximity to known infested sections.

Field operations in Kentucky led to discovery of a single borer in section no. 4, near Newport, in Campbell County. This section is near the Ohio River in one of the northernmost Kentucky counties. Only one new infestation, a find of three borers, was recorded in West Virginia. This find was made on a farm in Union township, Marion County. A single township intervenes between this infestation and previously regulated territory. A fairly scattered infestation throughout Bucks County, Pa., was indicated by observations of infestations in Nockamixon, Bridgeton, and Tinicum townships. Bucks County adjoins the 1-generation infested zone.

Scouting in Delaware and counties not known to be infested in New Jersey gave negative results. Surveys in the lower Eastern Shore sections of Maryland disclosed 5 infested districts in 2 counties. A farm in Willards district, Wicomico County, yielded two borers. In adjoining Worcester County, single infestation were found in the districts of Colbourne, Newark, and Snow Hill. In Stocktons district of the same county, infestations were found on two farms.

A single borer collected in Temperanceville district of Accomac County, Va., indicates that the clean-up of the small infestation discovered there in 1931 did not reach all borers in the section. In addition to the specimen collected in the Temperanceville district, first-record finds were made in Metompkin and Lee districts of the same county.

STATE COMPULSORY CLEAN-UP CAMPAIGNS

Probably the most vigorous of the compulsory clean-up campaigns undertaken by infested States were those conducted by Connecticut, Maine, Massachusetts, and Rhode Island. In Connecticut, a clean-up crew of 21 men, each supplied with a light truck, began their work in the southern half of the State on April 12. Examinations for cornstalks or stubble were gradually extended to the northern tier of counties. The survey was completed early in June. Only 3 prosecutions were necessary, 2 of which were occasioned by the refusal of owners to plow and burn cornstalks in compliance with the State orders.

Half an acre of sweet corn in which infestation was discovered in a suburb of Racine, Wis., was promptly cut and destroyed.

Several demonstrations of corn-borer-control implements were staged in cooperation with State or county agricultural officials in a number of Connecticut and Massachusetts localities.

FALL SURVEY OF INFESTATION

Surveys for degree of infestation were started in Indiana, Ohio, and Michigan on August 15 by 16 men withdrawn from the regular scouting crews for the purpose. In addition, the Bureau of Entomology furnished 6 experienced scouts, and the State of Indiana supplied 1 man for borer-population counts. Similar work in eastern seaboard infested States began shortly thereafter. Five men were provided by this Bureau for the work in the Middle Atlantic and New England States. Survey work in the western area was completed on September 15. In the eastern district it extended until September 23.

Data collected in the cooperative fall-infestation survey of 1932 were compiled by the Bureau of Entomology. In the 1-generation infested sections, significant borer increases over 1931 were noted in the southeastern Michigan counties south of Saginaw Bay and bordering on the bay and on Lakes Huron and Erie, as well as in the five additional counties in the southeastern corner of the State. Four other Michigan counties evidenced no change in borer population, and a decrease was registerdd in a single county of the State. Of 4 counties surveyed in northeastern Indiana 1 showed an increase, 1 a decrease, and the remainder no change in degree of infestation. More territory was covered by the survey in Ohio than in any other State. Northwestern Ohio counties bordering on Lake Erie and for several tiers south into the corn-growing sections disclosed no significant change in borers per hundred stalks over the previous year's records. Two counties bordering on Lake Erie in the northeastern corner of Ohio disclosed increases in infestation, as did 5 counties south of the older infested territory, and 3 northwestern counties. Champaign County, quite near the southern border of known corn-borer infestation, disclosed a rather generally distributed corn-borer population. In only one Ohio county was a decrease in infestation recorded. In Erie County, Pa., the only county surveyed in that State, examination of cornfields showed an increase in the number of borers per 100 plants. Surveys of 8 northern lake counties of New York showed decreases in 2 counties and no significant change in the others. Increased infestation in New York counties was confined to Cattaraugus County in the southwest and Schoharie County in the Albany district. Three counties in the Albany district, and Wyoming County in the western part of New York, remained unchanged in borer concentration.

In the 2-generation area, the infestation survey was extended to include recently infested territory in New Jersey, Connecticut, Massachusetts, Vermont, and New Hampshire. Data comparable to that obtained in the last fall survey, conducted in 1930 in the New England States, indicate considerable increase in the average number of borers per 100 plants throughout the area as a whole. Of the 2 counties surveyed in Maine, 1 showed no change in infestation and the other evidenced an increase in borer concentration. Increases were recorded in all three counties previously surveyed in New Hampshire. In Massachusetts, Essex and Barnstable Counties registered increases, Middlesex, Norfolk, and Bristol Counties decreases, and Worcester and Plymouth Counties an unchanged status. The greater part of Rhode Island showed no appreciable change in degree of infestation, although an increase was noted in Newport and Bristol Counties. Report was also received of the initial infestation of Block Island, off the coast of Rhode Island. Spread of the insect from the mainland to the island required a moth flight of from 20 to 30 miles from the towns of Middletown and Little Compton in Newport County. Considerable increase in general infestation was evidenced in Connecticut. A comparison of data from 1930 discloses approximately the same degree of infestation in New Haven and Windham Counties, and significant increases in Tolland, New London, and Middlesex Counties. A fivefold increase in larval population in Suffolk County, Long Island, was observed as a result of examination of the corn crop affected by the second-generation borers. Combined injuries by the corn borer, corn ear worm, and Stewart's disease resulted in a 50 percent reduction in the corn yield in this Long Island county.

Throughout the 1-generation area surveyed the average number of borers per 100 plants increased from 16.6 in 1930 to 31.7 in 1931 and 33.5 in 1932. Similar comparisons in the 2-generation area are 82.6 in 1929, 58.9 in 1930, and 91 in 1932. No 1931 fall survey was made in the latter area.

CONSOLIDATION OF HEADQUARTERS

Motor-vehicle, spraying, and other equipment on hand at the Springfield, Ohio, western-area headquarters was moved to New Cumberland, Pa., where it is now stored in a large warehouse at the general depot of the United States Army. With the transfer of the general headquarters from South Norwalk, Conn., to Harrisburg, Pa., in May, the personnel at Springfield was transferred to either the New Cumberland depot or to the Harrisburg headquarters. Both the Springfield and South Norwalk buildings were vacated at the end of the fiscal year.

Several members of the permanent corn-borer personnel were transferred from corn-borer to Japanese beetle rolls and assigned to enforcement activities under the Japanese-beetle quarantine.

Quantities of tools, farm implements, sprayers, and motor vehicles were reconditioned and transferred to the pink-bollworm and gypsy-moth projects.

JAPANESE BEETLE QUARANTINE AND CONTROL

EXTENT OF INFESTATION

The abandonment of visual field surveys by scouts and the substitution therefor of traps for the purpose of determining the presence or absence of the Japanese beetle (*Popillia japonica* Newm.) in nonregulated territory were responsible for discovery during the summer of 1932 of first-record infestations in greater numbers and at points farther removed from the infested sections than previously recorded. Catches ranging from 1 to 10 beetles were made in 94 cities and towns. Finds of so few beetles in a locality are largely indicative of incipient infestations, possibly of the current year's spread. Collections in sufficient numbers to indicate apparent overwintering infestations were made in 49 cities and towns. Catches at these 143 cities and towns not previously known to be infested totaled 3,688 beetles.

Observations in sections densely infested with the Japanese beetle indicated that the insect during the summer of 1932 probably caused greater destruction of fruit and produce crops than in any year since its discovery in 1916. For the past several years adult beetles have been known to cause considerable commercial damage to cut flowers grown throughout the winter and spring months in greenhouses in the Philadelphia zone. This condition has continued. A few instances have also been observed of heavy concentrations of larvae in uncertified nursery plots destroying evergreen stock, thus compelling the poisoning of the nursery block with arsenate of lead to protect the stock. Such treatment has been entirely for plant protection rather than in compliance with the quarantine requirements. Beetle population increases were sufficient in Long Island and Westchester County, N.Y., and the northeastern counties of New Jersey, to arouse public interest and require the attention of city foresters and park departments in combating the insect. Adult beetle flight of noticeable proportions took place in sections of Wilmington, Del., and Harrisburg, Pa. Through the county agent of Burlington County, N.J., heavy beetle damage to soybeans was reported for the first time, requiring early harvesting of the crop to prevent entire destruction of the stand.

Surveys were made for 7 weeks during the summer of 1932 to determine the extent of the sections in southern New Jersey, southeastern Pennsylvania, and northern Delaware in which Japanese-beetle defoliation or partial defoliation of favored food plants was conspicuous and readily observable from an automobile proceeding at a moderate rate of speed. Defoliation to the extent of between 75 and 100 percent was obvious over an area of 1,647 square miles. Damage of from 50 to 75 percent was evident in 1,378 square miles. Evidence of at least 25 percent foliage injury was observed over an additional area of 1,353 square miles. A total of 4,378 square miles was found infested to the degrees noted. Among the plants wholly or partly defoliated were apples, peaches, cherries, plums, quinces, lindens, willows, larch, young Norway maples, sassafras, horsechestnuts, grapes, raspberries, blueberries, blackberries, certain vegetables, and a number of ornamental plants. Adult feeding on the silk of field and sugar corn also resulted in reduced yields of these crops. In this densely infested section, heavy concentrations of grubs destroyed or badly injured the sod in many lawns and golf courses.

The regulated area as effective January 23, 1933, includes the New England States, with the exception of Maine and the northern halves of New Hampshire and Vermont; the Middle Atlantic States, exclusive of territory in northwestern Pennsylvania and northern New York contiguous to the lake region and Canadian border; together with the District of Columbia, the State of Delaware, and limited sections of Maryland and Virginia. Included in the regulated territory are 97,690 square miles. In addition to the main regulated zone, there are 10 small isolated regulated sections, 3 in Virginia, and 7 in Maryland. This enlarged area places under regulation all infestations of an apparently established nature. It is believed that the few beetles trapped in West Virginia, the Shenandoah Valley, western New York, Maine, Michigan, Ohio, North Carolina, and South Carolina are not indicative of established infestations warranting quarantine extension.

Field inspections by scouts in the summer of 1932 were confined to examination of 1,230 class I nursery and greenhouse establishments and nearby premises. Scout collections indicated that the insect had spread to 163 classified premises which in previous years had been found free from infestation. This is a much greater spread of the insect than took place last year, when initial infestations were found on only 126 classified nursery or greenhouse premises.

All field work to determine the present scope of the beetle outside the 51,339 square miles then under regulation was performed with traps. The 1932 field-inspection work was of greater scope than any previously attempted. Traps were in operation in all Atlantic Coastal States and in selected cities in States as far west as Michigan. In all, 45,721 traps were used in determining the presence or absence of beetles in nonregulated territory. In most communities examined, 400 traps were distributed at points of likely infestation. Traps on each route were periodically visited by a trap inspector. Experienced men with small trucks were assigned to supervise the work of a number of trap inspectors. Trapping was already in progress in Florida, Georgia, North Carolina, South Carolina, Virginia, Maryland, West Virginia, and Ohio at the beginning of the fiscal year. During July, trap distribution began in Pennsylvania, New York, Massachusetts, New Hampshire, and Michigan. Final placement of traps was made in Vermont and Maine during August. Throughout the summer traps were operated for periods varying from 30 to 60 days in 3 cities each in Florida and Georgia, 4 cities in South Carolina, 5 cities in North Carolina, and 3 cities in West Virginia. In the unregulated portions of States already partially quarantined, traps were in operation in 32 towns and cities in Virginia, 35 communities in Maryland, 50 localities in Pennsylvania, 43 localities in New York, and in 62 Massachusetts towns and cities. The New England trapping program was carried on in 6 cities each in Maine, New Hampshire, and Vermont. In the East North Central States traps were placed in 13 Ohio cities, in Detroit, Mich., and Richmond, Ind. Selection of these 273 towns and cities as sites for trapping activities was made on the basis of their ranking as transportation centers, as possible destination points of illegally transported infested produce or nursery stock, or as possible centers affording favorable environments for the establishment of a few beetles accidentally carried from the zone of heavy infestation.

Most remote from the regulated zone of the first-record finds are the infestations of a few beetles each discovered at Florence, S.C.; Winston-Salem, Raleigh, and Durham, N.C.; Roanoke and Lynchburg, Va.; Wheeling, W.Va.; Canton, Cleveland, Columbus, Steubenville, and Zanesville, Ohio; Detroit, Mich.; Buffalo, Niagara Falls, Rochester, and Syracuse, N.Y.; Bellows Falls, Brattleboro, Rutland, and White River Junction, Vt.; Dover, Keene, Manchester, Portsmouth, and West Lebanon, N.H.; and Augusta, Kennebunk, and Portland, Maine. Beetles in considerable numbers were collected at the site of the newly discovered infestation in Concord, N.H. In the unregulated portion of Pennsylvania, infestations in 27 localities were determined. Beetles were collected in 17 cities and towns in nonregulated territory of Virginia, and in 31 communities outside the then-restricted zone in Massachusetts.

An incipient infestation discovered at Charleston, S.C., in 1931 and surface treated the following fall with arsenate of lead failed to disclose any beetles in 1932. Nominal increase only was noted at previously discovered infestations in Annapolis and Chevy Chase, Md.; Boston, Mass.; Buffalo and Little Falls, N.Y.; Cleveland and Columbus, Ohio; Laughlintown, Ligonier, New Castle, Pittsburgh, and Tyrone, Pa.; and Richmond, Va.

Trapping activities for the summer of 1933 were fully organized in North Carolina, South Carolina, Virginia, and West Virginia by the end of the fiscal year. First placement of traps was made in Charleston, S.C., on May 27. The only first-record find recorded was a catch of two beetles at Emporia, Va.

SUPPRESSIVE MEASURES

Intensive eradication measures were applied at Erie, Pa. In conjunction with the season's trapping activities, surface application of lead arsenate was made to soil and sod in infested sections. Throughout the summer, trap inspectors made six applications of poison spray containing attractants to foliage in the infested district of the city. Traps distributed in Erie during 1931 yielded 170 beetles. Catches of 282 beetles were made in 1932, an increase which is not considered significant.

Application of lead arsenate to the two small sections in Detroit, Mich., where a few beetles were trapped in August 1932 was completed in September. This suppressive work was a joint project with the authorities of the State of Michigan and the city of Detroit. Similar poison application was made at the site where two beetles were trapped at Florence, S.C. Lead arsenate for the latter work was supplied by the State of South Carolina.

Community spraying for Japanese-beetle control, in cooperation with the Maryland State Horticultural Department, was carried on during June 1933 in

Laurel, Colgate, and near Elkton. These infestations are separated from the continuously infested sections centering about Philadelphia. Infestations in these localities approach conditions found in the densely infested sections farther north. Excellent coverage with coated lead arsenate of all foliage in the sprayed communities assured protection to vegetation, some of which during several years past has been subject to complete defoliation. Instead of adding geraniol and syroline to the spray mixture, as was done at Erie, Pa., during the summer of 1932, perforated metal cages each containing a small jar of geraniol-eugenol mixture, equipped with a wick for volatilizing the liquid, were hung in sprayed shrubs and trees of the species known to be preferred food plants of the insect. Beetles thus attracted to the poisoned foliage consume enough of the lead oleate-lead arsenate insecticide to receive a toxic dose.

Beetle depopulating demonstrations were performed in Philadelphia, Pa., and Trenton, N.J., during the summer of 1932. In Philadelphia, the operation of 472 traps for a period of 9 weeks on 6 poisoned plots planted to a preferred food plant of the insect resulted in catches of about 2,800 pounds of beetles. Maintenance of 63 traps at Trenton during the season resulted in a total catch of over 633,000 beetles. Despite the quantities of beetles collected in connection with these demonstrations, the number of the insects in the immediate vicinity of the traps was not greatly depleted.

Large-scale trapping activities initiated during July and August by the State of New Jersey in the densely infested sections of Salem County, in southern New Jersey, resulted in the collection in 2,100 traps of over 500 millions, or 55 tons, of beetles.

An improved method of baiting the traps was adopted, liquid bait, containing geraniol and eugenol, being substituted for the bran bait mixture formerly used. Small jars equipped with wicks are used to vaporize the oils. The advantages accruing from the use of the liquid bait are reduction in time required to prepare the bait, reduced bulk and weight, and consequent lower haulage costs in moving large quantities of trap equipment for long distances.

ROAD STATIONS

Border patrol stations, established during the previous April, were already in operation on 18 highways at the beginning of the fiscal year. These vehicular-inspection stations were concentrated on the highways leading from the regulated sections of Pennsylvania, Maryland, and Virginia. Highways chosen for the road-inspection work were the mainly traveled routes from heavily infested zones to points west and south. Thirteen of the stations were continued until fall. Five other stations were closed and reopened as the seasonal movement of quarantined articles justified. Road-inspection work was discontinued for 1932 with the closing between November 9 and 26 of the 17 stations then in operation. The 1933 border-patrol activities began with the reestablishment of stations in Maryland and Virginia late in March. Reorganization of the work in Pennsylvania and New York followed as rapidly as inspectors could be instructed in their duties. At the close of the fiscal year 25 established road-inspection stations were located at the borders of the regulated territory in Virginia, Maryland, and along the Pennsylvania-West Virginia and Pennsylvania-Ohio State lines. A roving patrol of 4 Pennsylvania State inspectors covers 8 roads leading into the nonregulated section of northwestern Pennsylvania. Another Pennsylvania inspector maintains an established post. Road-inspection work was revived in New York State with the establishment in mid-April of a mobile patrol of four State-employed inspectors who alternate their hours between 10 highways over which most of the quarantined articles move west from the regulated portion of northern New York.

Stations in operation during the fiscal year stopped 1,349,323 road vehicles, 15,729 of which were found to be carrying contraband material. Among the insect material removed from the contraband surrendered at the road stations were 253 grubs and adults of the Japanese beetle.

CERTIFICATION AND TREATMENT OF NURSERY STOCK

Under a revised interpretation of the nursery classification regulations, effective in October, class III status is now confined exclusively to establishments on which beetles or grubs have been found, or establishments quite definitely determined as in a generally infested section and within 500 feet of which beetles have been collected. Under this interpretation of the regulations 68 nurseries which had been given a class III status were reassigned to class I, and thereby

permitted to ship their stock without chemical treatment or freeing it from soil. All establishments returned to class I were scouted during the summer of 1932 and their actual premises found free from beetles.

A joint certification plan was inaugurated in the spring of 1933 whereby, in territory in which inspection and certification requirements under the gypsy-moth and Japanese-beetle quarantines overlap, inspections may be made and certificates issued by either the gypsy-moth or Japanese-beetle inspector. Inspectors performing this joint certification are supplied with rubber stamps with which they may affix to packages containing inspected material a joint certificate showing compliance with both Quarantines Nos. 45 and 48. All men thus engaged were instructed in their duties by the appropriate cooperating project. Records of the materials jointly certified are furnished to the field offices of both projects.

Nursery and greenhouse establishments maintaining classified status under the quarantine regulations have increased in number during the year from 1,676 to 2,424. While extension of the area accounts for a large proportion of the increase, surveys within the previously regulated territory to acquaint plant growers with their privileges under the regulations have also resulted in the addition of many classified premises. Since the recent extension of area, many shippers in centrally located sections of the regulated territory have relinquished their classified status, as their shipments of plant material are now wholly within the zones under regulation.

With the growth of the regulated territory and the increase in the number of classified nurseries and greenhouses in infested sections, supervision of interdealer movement of certified stock between classified establishments has grown to considerable proportions. Since classified establishments are obliged, under the precautions necessary to assure eligibility of their entire stock, to receive only certified stock on their premises, large quantities of stock moving to such premises require inspection and certification, although portions of material so received may not eventually be reshipped to nonregulated States.

Results of analyses by chemists of the Technological Division of soil samples collected in lead-arsenate-treated nursery plots and coldframes were made available from April to June. Upon receipt of the data, the information was in turn transmitted to the nursery concerned. As a result of the analyses, 44.5 acres of nursery plots and frames, containing 210,887 plants, were re-treated prior to July 1 with lead arsenate in sufficient quantity to restore the treated frames or plots to the prescribed dosage of 1,500 pounds per acre.

A supplement to the requirements for the disinfection of nursery products issued in August 1932 permits the treatment of potting soil with lead arsenate. Previously soil for use in potting plants later to be shipped under certification required treatment in a closed container with raw carbon disulphide. Treatment of the soil with lead arsenate must be performed prior to August 1. The poisoned soil may then be used between October 1 and the following June 15.

CERTIFICATION OF FRUITS, VEGETABLES, AND CUT FLOWERS

Seasonal regulation of movement of quarantined farm products became effective on June 15. Rapid disappearance early in September of adult Japanese beetles made possible lifting of the farm-products-certification requirements on September 17. Active adult flight of the insect ceased several weeks prior to the lifting of the summer restrictions. What few beetles were still in evidence in mid-September were largely inactive, confining their feeding to the blooms of specially favored food plants, such as the dahlia. This latter condition made it necessary that the inspection and certification of all cut flowers moving to nonregulated territory be maintained until October 15. Inspectors operating in the wholesale-cut-flower establishments in Philadelphia were still removing beetles from inspected blooms as late as September 30.

The presence of large numbers of adult beetles in the market and waterfront districts of Philadelphia persisted from July 12 to August 12. As has been the practice in past years, inspection service during this period was confined to the daily hours of beetle inactivity.

Fruits and vegetables subject to quarantine restrictions during the summer of 1932 were limited to nine farm products which are especially susceptible to beetle infestation in the fields where grown. Reduction in the number of classes of farm products under restriction and enlargement of the New York regulated area considerably curtailed the amount of quarantined farm products and cut flowers shipped under certification. Despite the reduced quantity of articles

offered for inspection during the seasonal quarantine, approximately 45,500 lot shipments of these certified articles moved from the regulated area. Inspections were made at 67 inspection centers conveniently scattered throughout the infested zone, and 1,843 beetles were removed from articles presented for inspection.

Construction of a fumigation house was completed in the spring of 1932 by a cooperative blueberry grower's association at New Lisbon, N.J. All blueberries certified for movement from the regulated zone, and a large proportion of berry shipments to infested sections, were fumigated with carbon disulphide. Although fumigation of the latter shipments is not required as a requisite for their movement, the chemical treatments were made to kill any Japanese beetles that might be present in the cellophane-wrapped packages. Japanese beetles feeding in such closed packages have been found to affect the salability of quality berries. The municipally owned fumigation house at Hammonton, in the blackberry- and raspberry-growing sections of southern New Jersey, was continued in operation while beetles were in flight during the summer of 1932.

Modification of the requirements for the disinfection of bananas unloaded from boats docked at Philadelphia during the active flight period of the insect permitted the use of liquid hydrocyanic acid gas as a fumigant for refrigerator cars loaded with this product. Heretofore a calcium compound of the acid had been prescribed as the medium for liberating the poisonous gas. This modified practice permits a reduction in the cost of materials per car from approximately $3.45 to $0.38. Greater care must be exercised in injecting the quickly volatilizing liquid into the car and the operator is equipped with a gas mask, which was unnecessary when the solid form of fumigant was used.

Commercially packed apples are exempt from the requirements for certification under the quarantine regulations effective at the beginning of 1933. For quarantine purposes, the definition of commercially packed apples is restricted to apples in closed barrels, boxes, or baskets, of sizes and types customarily used in the apple trade, or apples in open packages when such apples have been graded above the grade of Unclassified in accordance with official State or Federal standards and the containers are marked with such grade.

Demand for inspection and certification of string beans from infested fields in southern New Jersey resulted in the development of a mechanical beetle separator, since beans cannot be fumigated without injuring them. Construction of several separator models finally resulted in the adoption of a type of machine involving essentially a sloping, revolving cylinder 7 feet long, covered with ½-inch mesh wire, and mounted on an iron frame. Beans are poured through a hopper into the higher end of the cylinder. As the cylinder is revolved by means of a hand crank, the beans tumble without injury to the lower end of the cylinder, where they empty into a hamper. Any beetles present are shaken off and fall through the wire mesh. Surrounding the inner cylinder is a similarly constructed cylinder of larger diameter to catch any beans which may slip through the meshes of the inner cylinder. In tests conducted with the machine and with inspectors making visual inspections of the beans, the mechanical separator in every case proved more efficient than the inspector in ridding beans of known infestations of beetles.

Inspection and certification of green stringless beans and wax beans from an extensive bean-growing section within a radius of 20 miles of Baltimore, Md., were handled largely through the periodic scouting of 425 bean farms, and the accrediting of uninfested growing sections. Bean shippers in Baltimore desiring subsequent certification of their purchases in carload lots receive in their screened bean houses only certified beans. Beans from accredited farms receive immediate certification. Products from infested fields require inspection at a platform maintained in the market district during the effective period of the seasonal quarantine on fruits and vegetables.

SUMMARY OF CERTIFICATES ISSUED AND OF VIOLATIONS INVESTIGATED

A total of 554,056 certificates of all types was issued during the 12-month period.

Table 4 shows the quarantined articles intended for shipment from the regulated area and for use in certified greenhouses, or surface soil in nursery plots, heeling-in, or plunging areas, which were fumigated or sterilized during the fiscal year.

TABLE 4.—*Materials fumigated or sterilized under Japanese-beetle-quarantine regulations, fiscal year 1933*

Material treated		Number treated with—				
		Arsenate of lead	Carbon disulphide gas or emulsion	Naphthalene	Steam	Hydrocyanic acid
Plants	number	417,548				
Potting soil	cubic yards	4	2,639		717	
Mushroom soil	do		369			
Manure	do		25		34	
Leaf mold	do				15	
Sand	do		1,191		80	
Peat	do		5			
Surface soil	square feet	314,827	14,881	2,159		
Surface soil with plants	do	2,671,070				
Bananas	bunches					94,459
Berries	crates		14,966			

Nursery and ornamental stock, sand, earth, peat, compost, and manure were certified for shipment from the regulated areas during the fiscal year in the following quantities:

Plants	number	34,268,557
Sand, earth, and clay	carloads	3,809
Peat	do	83
Manure and compost	do	174

Fruits, vegetables, moss, and cut flowers certified during the seasonal quarantine on these articles were as follows:

Fruits and vegetables	packages	3,629,434
Moss	bales	355
Cut flowers	packages	49,737

Over 1,000 reports of apparent violations of the Japanese-beetle-quarantine regulations were received from all sources during the 12-month period. Investigations were made of all such irregularities, and proceedings were instituted in United States district courts for eight violations of the Plant Quarantine Act arising from shipments contrary to the regulations.

STATE AND MUNICIPAL COOPERATION

Mutually satisfactory relations continued with officials in cooperating States. Appropriations for regulatory and control work were available from the States of Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island, and Virginia. In addition, the State of South Carolina supplied lead arsenate for the treating work in Florence, and the Michigan State and city authorities concerned cooperated in financing the treating work in Detroit. Numerous community spraying campaigns locally financed in heavily infested cities were again repeated in 1932. Considerable spraying work was performed by private contractors in the environs of Philadelphia. Beetle-collecting contests were held by a number of garden clubs or local officials in newly infested territory. The application of lead arsenate in large quantities to lawns on infested estates and to private golf courses in Philadelphia suburbs has come to be a common practice.

PINK BOLLWORM

ERADICATION MEASURES IN FLORIDA

The pink bollworm (*Pectinophora gossypiella* Saunders) was discovered infesting a species of wild cotton in southern Florida in June 1932. Such of this cotton as grew along the highways and in other easily accessible places constituted an especial danger, as tourists and other travelers could unintentionally distribute the insect to new localities. The eradication of this roadside cotton was therefore immediately begun and was soon completed to the extent that one could pass through the area without finding wild cotton, unless he should take special pains to do so.

A survey was then started to locate all cotton, either wild or domestic, in the southern part of the State. Commercial cotton is not grown south of Alachua County, with the exception of a few small experimental plantings in Sumter, Pasco, and Hillsborough Counties. Wild cotton was, however, found growing along the coast and on keys or islands. On the east coast, the only wild cotton found above Miami consisted of four small colonies on a peninsula in Brevard County, opposite the town of Grant. On the west coast, wild cotton occurs rather generally on both the mainland and adjacent keys from Cape Sable northward to St. Petersburg. The only wild cotton found above this point was a small colony located on a key near Hudson, in Pasco County.

In connection with this survey, it was found that a considerable percentage of the wild cotton was infested. Infestations were discovered along the west coast as far northward as Terra Ceia Island, in Manatee County, while on the east coast the most northerly infestation was discovered on dooryard cotton plants at Lake Worth, in Palm Beach County.

Field inspection of commercial plantings of cultivated cotton in north-central Florida, and the operation of one of the portable gin-trash machines there resulted, on September 26, 1932, in the finding of a specimen in trash from the gin at High Springs, in Alachua County. Inspectors were immediately concentrated in this area, and on October 10, 14 specimens were found in a field 10 miles northwest of High Springs, in Columbia County. Another specimen was found in this same field the following day. On October 8 a pink bollworm was found with the machine in trash from a gin at Lake City, and by field inspection an infestation was located in a field 5 miles southwest of Alachua, in Alachua County, on October 26, two specimens being taken. Field and gin-trash inspections were continued as long as material was available, but no other specimens were found.

As a result of these discoveries, a public hearing was held to consider the advisability of extending the quarantine to cover this area. It developed that several counties east and south of Alachua and Columbia Counties did not have ginning facilities, the cotton produced in such counties being ginned in the infested counties. For this reason Baker, Bradford, Union, and Gilchrist, together with Alachua and Columbia Counties, were placed under regulation effective October 29, 1932. An inspector was placed at Lake City to supervise compliance with the various regulations.

Not a great deal of cotton was grown in the immediate vicinity of the two infested fields, and it was therefore possible to clean all fields within a 5-mile radius of each known infested field. This was done following the conclusion of cotton picking and was completed in December. A total of 169 fields, covering 847¼ acres, was cleaned in the two counties. The average cost per acre for labor and for fuel for burning the material was $2.43. The six gins operated in the two counties were thoroughly cleaned at the end of the season; so also were the three oil mills in southern Georgia which had handled seed from the area.

Most of the cotton had been ginned before the regulated area was established. As the gins were not equipped with facilities for sterilizing the seed, a portable sterilizer was constructed and sent to the area. The seed belonged to a number of different individuals and firms, and while the bulk of it was more or less concentrated, it was necessary to bring the seed to the machine from some 40 different locations. An accurate record was kept of the heat of the seed as it was run through the machine. Approximately 90,000 pounds of seed were sterilized. Germination tests were later made, and they showed that the sterilized seed had slightly better germinating qualities that did the unsterilized seed.

As a result of the survey made in the fall, it was found possible to eliminate the wild cotton from southern Florida and the adjacent islands. This work was begun early in the calendar year 1933. By the end of June, all the cotton on the west coast from Naples northward had been destroyed, thus widening the gap between the wild cotton and domestic plantings by fully 150 miles, making the total distance about 300 miles. The wild cotton on the east coast was also destroyed, but a considerable amount still remains on the islands in Florida Bay and on Cape Sable. None of the cotton on Cape Sable can be reached until the next dry season.

During this eradication campaign over 625,000 mature, 816,000 seedling, and 19,000 sprout plants have been destroyed. By seedling plants is meant those up to the size of walking canes; mature plants are any plants larger than this. Some of the mature plants reach a height of 15 to 20 feet and are 5 or 6 inches in diameter, although the majority are not so large. Many wild and domestic cotton plants are grown in yards as ornamentals, and during the eradication work these have also been destroyed. After the danger was explained, all the owners, except 1 or 2, allowed such plants to be destroyed.

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The eradication of the small, experimental plantings of cultivated and wild cotton at Chapman Field has been carried on in cooperation with the Bureau of Plant Industry. A few plants have been left in each of the plots so as to avoid any possibility of driving the pests to some other malvaceous plant. All the fruit was removed from the plants which were left, and throughout the year the blooms have been removed daily. These blooms were found to be infested during the summer of 1932, but from October 7 to March 3, 1933, the examinations were negative. During the period March 3 to 24, 1933, 11 pink-bollworm larvae were taken from blooms in one of the plots, but all examinations between then and the end of the fiscal year have been negative. This would apparently indicate that the light infestation was due to overwintering larvae in the soil and not to reinfestation from outside sources.

CLEAN-UP OF BIG BEND AREA OF TEXAS UNDERTAKEN

The Big Bend section of Texas is comprised of the counties of Brewster and Presidio, most of the cotton acreage being in Presidio. During the 1931 crop season the infestation was heavier than ever before, practically all bolls being infested before the end of the season, and the loss to farmers was exceedingly heavy. Early investigations indicated that the infestation would be even heavier during the 1932 crop season. Such intense infestation makes the prevention of spread by quarantine methods all the more difficult, and plans were accordingly made to try to reduce this infestation to insure that the quarantine would give the necessary protection to the Cotton Belt proper. The plans were to make a thorough clean-up of the fields after picking had been completed, have the farmers delay the planting date for the following crop, and make use of trap plots of cotton.

Complications, however, prevented these plans from being carried out in full detail. In the early part of September a flood came down the Conchos River of Mexico, which empties into the Rio Grande about 2 miles above Presidio. All the cotton acreage on the Mexican side of the river, and approximately 1,200 acres in Presidio County, were flooded. About 3 weeks later floods came down the Rio Grande and the Conchos River at the same time and covered practically all the cotton acreage of the Big Bend. This made the field clean-up much more difficult than it otherwise would have been. Silt was deposited about the fields which prevented the use of machinery; it was necessary, therefore, to cut the stalks with machetes and have the clean-up done by hand.

The work was begun early in November and completed the latter part of January. A total of 4,106 acres was cleaned at an average cost of $4 per acre. There was considerable drift material along the river containing cotton which had been washed from the fields, and after the field clean-up was completed, this drift material was burned. Following this a house-to-house canvass was made, and all places where cotton had been stored were cleaned as were also all trucks and other vehicles which had been used to transport cotton. All seed cotton in mattresses and pillows was replaced with linters.

The peak of moth emergence in the Big Bend is completed by the latter part of May. Cotton planted after April 15 does not have blooms before the middle of June; therefore, all farmers were requested not to plant cotton before this date (April 15), so that the peak of moth emergence would be over before the cotton reached the point where the insect could be propagated. Every farmer willingly obeyed this request, as they were all familiar with the damage the pink bollworm could do.

In order to attract moths emerging later in the season early plots of cotton were planted in advance of the main crop to act as traps. This plan had worked out very well in the Salt River Valley of Arizona, where stub cotton could be used as a trap. Such stub cotton was not available in the Big Bend; therefore, it was necessary to plant cotton in hotbeds and later transfer it to the fields. After an early set-back from cold weather, this cotton began growing very nicely and had blooms about a month in advance of the main crop. A total of 67 plots, containing about 200 plants each, were set out, which gave an average of 1 plot to each 37.7 acres of cultivated cotton. The blooms from this cotton were collected daily, and after being inspected they were burned. The first infested blooms were collected early in June. By the end of the fiscal year infested blooms were being found in 47 of the 67 plots. A few blooms were beginning to appear in the commercial cotton fields, and infested blooms had been found in some 14 fields, but the pink-bollworm moths were clearly being attracted to the early cotton plots much more readily than to the cotton fields.

In connection with the work in the Big Bend, there was some apprehension that the two floods might have carried infested material down the river to points where cotton is grown, and thus spread infestation. Therefore, during the crest of the second flood, which was considerably higher than the first, inspectors of this project and of the port and border service, working in cooperation, were stationed on bridges and other points of vantage from Del Rio to Brownsville to make observations of the drift material carried by the river. In no case was any cotton debris seen. After the lowlands along the river had dried sufficiently, a thorough examination was made of the drift material from Eagle Pass northward for a distance of about 65 miles. Several cotton stalks, bolls, and small seedling plants were found near Eagle Pass; however, it later developed that this material undoubtedly originated from some 300 acres of cotton along the river in Mexico, above Eagle Pass, which had been flooded and some of the cotton washed away. No cotton debris of any kind was found above this point. After this work was completed a thorough inspection was made of all cotton fields within 5 miles of the Rio Grande from Laredo southward to Brownsville. All the inspections were negative. The evidence indicated that the floods did not carry infested material from the Big Bend to the cotton fields southeast of Laredo, a distance of over 500 miles.

SALT RIVER VALLEY

Intensive inspections were made during the year in the Salt River Valley where eradication measures have been under way. The inspection of squares and bolls was begun as soon as they were available in the spring of 1932, most attention being given to the Laveen and Goodyear areas in Maricopa County, where the only infestations found in the 1931 crop season were located. Field inspections were continued during the summer until the ginning season got under way, after which they were replaced by gin-trash inspection, six machines being operated during the peak of the ginning season. Practically all the available trash was inspected. Toward the close of the season, in the spring of 1933, field inspections were resumed, and a supply of bollies was also collected. Inspection of the bollies had not been completed by the end of the fiscal year; but the results of the inspections so far as they had been finished in the Salt River Valley were all negative, and it is hoped that the infestation in that valley may have been eradicated.

COMPENSATION CLAIM BOARD

The work of the Compensation Claim Board in connection with claims arising out of the 1930 noncotton zone in Arizona, authorized under the provisions of Public Resolution No. 42, approved February 8, 1930, which has been discussed in previous annual reports, was completed with the close of the fiscal year 1933. During this fiscal year awards were submitted by the Board on seven claims, on which payments were made totaling $2,269.88.

At the close of June 30, 1933, the Federal Government had paid 945 claims, representing 39,519.3 acres, in the total amount of $635,982.10, which included $14,304.12 paid on the claims of Indian farmers. The total amount paid, deducted from the original appropriation of $675,000, left an unobligated balance of $39,017.90 which reverted to the general funds of the United States Treasury at the close of the fiscal year.

Under the provisions of the said public resolution these claims were paid by the Federal Government on the agreement by the State of Arizona, except as to Indian claims, to reimburse the United States Treasury in one half of the amounts so expended, or the sum total of $310,838.99. Of this amount the State has paid $309,704.05, leaving a balance due the Federal Government of $1,134.94, not including interest, pending payment at the close of the fiscal year.

A complete statement of Federal payments, State reimbursements, and net costs of claims arising out of the noncotton zone of 1930 is given in table 5.

TABLE 5.—*Federal expenditures and State reimbursements on claims arising out of the noncotton zone of 1930 in Arizona*

Item	Total claims	Total acreage	Payments	Total payments
Federal payments—	*Number*	*Acres*	*Dollars*	*Dollars*
To Indian farmers	100	756	14,304.12	
To white farmers	845	38,763.3	621,677.98	
				635,982.10
Reimbursements by the State of Arizona to the Federal Treasury:				
Fiscal year 1932			[1] 163,750.00	
Fiscal year 1933			[1] 145,954.05	
Fiscal year 1933, payment pending			[1] 1,134.94	
				310,838.99
Net cost to Federal Government of noncotton zone claims				325,143.11

[1] Amount represents principal and does not include interest on overdue payments.

SITUATION IN OTHER INFESTED AREAS

Intensive gin-trash inspections were carried on in the Midland, Tex., district during the season, two machines being operated at the peak of the ginning operations. In addition, field inspection was performed in Ector and Andrews Counties, where the cotton acreage is too small to support a gin. A supply of bollies was also collected, and the examination of these has already been completed. All results in the Midland district were negative. In the remaining districts only enough gin-trash inspection was performed to obtain accurate information as to the degree of infestation. It was found that the infestation in El Paso County was heavier than ever before, but in the remaining districts it was lighter. Hand inspection of gin trash in the Juarez Valley of Mexico, which is adjacent to the El Paso Valley, showed that infestation in this district was also heavier than last season. The number of bushels of gin trash inspected and the number of specimens collected in each of the districts under regulation are given in table 6.

TABLE 6.—*Summary of gin-trash inspection for the pink bollworm in regulated areas, crop season 1932*

District	Gin trash inspected	Pink bollworms collected	District	Gin trash inspected	Pink bollworms collected
	Bushels	*Number*		*Bushels*	*Number*
Midland, Tex	3,426	0	Duncan Valley, Ariz. and N.Mex	73	0
Pecos Valley, N.Mex	1,505	16	Safford Valley, Ariz	1,621	2
Pecos Valley, Tex	936	75	Salt River Valley, Ariz	60,454	0
Big Bend, Tex	34	47,602	Tucson, Ariz	80	0
Hudspeth County, Tex. (southeastern part)	142	1,926	Northern Florida	352	2
El Paso Valley, Tex	525	1,207	Total	70,933	50,947
Mesilla Valley, Tex. and N.Mex	1,749	115			
Tularosa, N.Mex	36	2	Juarez Valley, Mexico	71	2,010
Deming, N.Mex	0	0			

INSPECTIONS OUTSIDE OF REGULATED AREAS

During the two previous crop seasons, inspections in States east of the Mississippi River have been limited to laboratory inspection of green bolls. The finding of pink-bollworm infestation on wild cotton in southern Florida, previously mentioned, made it necessary to do more thorough scouting in these States, and a separate inspector was accordingly stationed in Alabama, Georgia, and Mississippi, and one inspector for North Carolina and South Carolina combined. In addition to gin-trash inspection, these men collected green bolls and bollies for laboratory inspection and did a small amount of field inspection. In addition to these States, gin-trash inspections were also made in Arkansas, Louisiana, Tennessee, Oklahoma, Texas, Arizona, and California. A machine was also operated

at Mexicali, Lower California, about 2½ months. A total of 89,406 bushels of gin trash was inspected outside of the regulated areas, the results all being negative. It takes approximately 10 acres to produce a bushel of gin trash; therefore the number of bushels examined would represent the inspection of 894,060 acres. The number of bushels of gin trash inspected in each State is shown in table 7.

TABLE 7.—*Summary of gin-trash inspection for the pink bollworm outside regulated areas, crop season 1932*

State	Gin trash inspected	State	Gin trash inspected	State	Gin trash inspected
	Bushels		*Bushels*		*Bushels*
Alabama	2,975	Louisiana	3,362	Texas	37,629
Arizona	4,074	Mississippi	2,309	Lower California, Mexico	13,561
Arkansas	2,653	North Carolina	746		
California	7,760	Oklahoma	3,373		
Florida	2,460	South Carolina	1,951	Total	89,406
Georgia	5,524	Tennessee	1,029		

As in previous years, a quantity of green bolls was collected from the various cotton States, these collections being largely confined to areas where no other means of inspection were available. This season approximately 11,704 samples of 100 bolls each were collected; also, 1,405 bushels of bollies. The inspection of this material is now nearing completion. In addition, samples of cottonseed were collected from the Delta area of Mississippi, Arkansas, and southwestern Tennessee, where cotton production is extremely heavy and the amount of gin-trash inspection was not considered sufficient. These seed samples were collected late in the season from representative gins and oil mills, a total of 7,400 pounds being secured in 10-pound samples. The inspection of these samples is also nearing completion. The results of this inspection have been negative to date.

CHANGES IN REGULATIONS

There were three changes made in the pink-bollworm-quarantine regulations during the fiscal year 1933. The first change, effective September 15, 1932, released from the fumigation requirement cotton produced in Grant and Hidalgo Counties, N.Mex., and in Maricopa and Greenlee Counties, and those parts of Pinal and Graham Counties, Ariz., not under additional regulations on account of the Thurberia weevil.

The second change became effective October 29, 1932, under which the following counties in Florida were added to the regulated area: Alachua, Baker, Bradford, Columbia, Gilchrist, and Union.

The third change became effective on February 28, 1933. Under this change the following counties in Texas were released from the regulated area: Loving, Winkler, Andrews, Ector, Crane, Upton, and that part of Midland County which had been under regulation.

CONTROL MEASURES ENFORCED TO PREVENT SPREAD

The most important safeguards which have been in force for a number of years to control and prevent the spread of the pink bollworm from infested areas are (1) disposal of gin trash, (2) sterilization of seed, (3) supervision of oil mills, (4) fumigation and compression of lint, and (5) road-inspection stations.

Disposal of gin trash.—Gin trash is disposed of daily by burning, sterilization, or grinding, as many pink bollworms are discharged in this trash during the process of ginning. The State regulations of Texas and New Mexico require this daily disposal of trash up to December 1 of each year, the average killing-frost date being prior to this, after which the trash may be returned to farms for feeding, fertilizer, or other purposes. In areas where a killing frost has not occurred prior to this date, the ginners have always cooperated whole-heartedly in continuing the daily disposal of trash until there has been a killing frost.

Seed sterilization.—One of the most important and useful measures in preventing the spread of the pink bollworm is seed sterilization. All gins in the regulated area are equipped with sterilizers, whereby the seed is heated to a temperature of 145° F. as a continuous process during ginning, the sterilizers being equipped with thermographs so that the temperature of the seed is recorded

at all times. Prior to the 1932 ginning season a survey was made of all sterilizer equipment and any serious defects corrected, so that seed sterilization was more efficient last season than ever before. A new method of installing the thermograph bulb was worked out by the Technological Division of the Bureau, and was in use at many of the gins. Practically all of the remaining ginners expect to make the installation before the next season, as it gives a more accurate reading and also results in considerable saving in fuel to the ginners. During the 1932 crop season, 126 machines were operated, and they handled approximately 80,541 tons of seed.

Supervision of oil mills.—The lack of oil mills in certain parts of the regulated areas makes it necessary to authorize mills outside, but close to such areas, to handle quarantined seed. This season the mills at Colorado and Sweetwater, Tex., were again designated, and after a regulated area was established in northern Florida, mills at Tifton, Camilla, and Valdosta, Ga., were designated. The seed is hauled to the mills in sealed cars and segregated until crushed, the cars being thoroughly cleaned before being released. The seed is required to be crushed in such manner as to destroy the pink bollworm and, to prevent contamination, finished products are required to be segregated until treated in accordance with the regulations. Approximately 80,000 tons of seed were crushed at the 20 mills operating this season. A number of mills are equipped with the roller system for treating second-cut or mill-run linters, 8,752 bales being so treated.

Fumigation and compression.—Fumigation plants were operated at Alpine and El Paso, Tex., and Tucson and Phoenix, Ariz. The plant at Phoenix operated only a short time, as that area was released from the fumigation requirement early in the season. The greater part of the regulated area is now designated as lightly infested, so that only 7,150 bales of lint and 1,727 bales of linters were fumigated during the season. In addition, 212 bales of linters from the Juarez Valley of Mexico were imported and fumigated at El Paso, Tex. At the 5 compression plants operated, 122,221 bales of lint and 2,684 bales of linters were compressed during the season.

Road stations.—Road-inspection stations were operated at Alpine, Fort Davis, and Van Horn, Tex., and Las Cruces, N.Mex. The station was at first operated at Las Cruces as a further protection against the eastward movement of infested material from regulated areas of Arizona. After the fumigation requirement was removed from these areas it was not felt that this station was warranted, therefore it was discontinued on September 15, 1932. The three stations in Texas were established as a protection against the movement of infested material from the Big Bend area. After the clean-up was completed in the Big Bend, there was no material left which might spread infestation, therefore these three stations were discontinued on January 31, 1933. During the period the stations were in operation 36,307 automobiles were inspected, and 286 articles were confiscated. The material confiscated consisted of 172 lots of cottonseed, lint, or seed cotton, 5 cotton plants containing bolls, 5 cotton-picking sacks, 69 quilts, pillows, or mattresses, made of seed cotton, and 10 miscellaneous articles. In addition, 185 cotton-picking sacks were treated and passed, and 18 automobiles, trucks, and trailers were cleaned before being allowed to pass the station. Three of the confiscated articles were found to be infested with the pink bollworm, 14 living and 14 dead larvae being taken. It is of interest to note that the live specimens were found in seed cotton, while the dead specimens were found in cottonseed which had been sterilized.

Cooperation with Mexico.—In previous years some of the cotton produced in the Juarez Valley of Mexico, which is immediately adjacent to the El Paso Valley of Texas, has been imported into the United States. In order to facilitate the issuance of permits, gins in this area are equipped with seed sterilizers and are operated under the direct supervision of inspectors of this project. The two oil mills in that area are also operated under direct supervision, and as all the seed is sterilized, cake and meal produced at these mills are allowed entry into the United States under permit. The Mexican authorities and citizens involved have always given the best of cooperation in carrying on these activities.

THURBERIA WEEVIL

The principal characteristics of the Thurberia weevil and its importance have been fully discussed in previous reports. The area infested by this insect is the Santa Cruz Valley in Pima County, Ariz. The cotton acreage has decreased, due principally to the difficulty in obtaining water for irrigation, until there are now only some 800 acres in cultivated cotton. Field inspections were made

earlier in the season, and after ginning began the inspection work was confined to the examination of gin trash. One gin was sufficient to take care of the acreage planted, and as a result there was not sufficient trash available to justify the operation of a machine. Therefore, the inspection of such trash was all done by hand, and it was possible to inspect practically all the trash produced. No specimens of either the Thurberia weevil or the pink bollworm were found in the gin trash. On January 13, 1933, specimens of the Thurberia weevil were found while a field near Marana was being inspected. Later, inspections in this same field resulted in the finding of additional specimens, a total of 65 being found during the period January 13 to 25. The inspection of all other fields in the area was negative. A supply of bollies was collected and is now being inspected, no additional specimens having been found in any of the material examined to date. Specimens were found in two fields near Eloy, in Pinal County, last season. Intensive inspections in this area during the present season have all been negative.

The same safeguards used in controlling the pink bollworm are also used against the Thurberia weevil. These include the disposal of gin trash, sterilization of seed, compression and vacuum fumigation of lint, and clean-up of gins, oil mills, etc., at the close of the season's operations. The results of each of the above activities are included in the figures given for the pink bollworm.

MEXICAN FRUIT FLY

INFESTATIONS IN TEXAS

The most important development in the Mexican fruit fly eradication program in the lower Rio Grande Valley of Texas was the remarkable decrease in the number of fruit flies taken during the fiscal year, following the intensive suppressive measures carried out the previous season. A total of 2,396 specimens of fruit flies had been taken from 61 groves during the winter and spring of 1932. Despite the intensive inspections carried on during the past season, no larvae could be found in valley fruit and only six adult flies were caught in the traps. Of these, 3 were taken in January and 1 each in March, April, and May. Four of these adults were trapped in Hidalgo and two in Cameron County. None was taken in Willacy County. Only one of these groves, that of the Texas Agricultural Experiment Station at Weslaco, was found infested in the fiscal year 1932.

A number of factors contributed to this decrease in the fly population of the valley. The bearing trees of the quarantined counties were sprayed in July 1932 and again in August with a nicotine-molasses spray. The thorough cleaning of all groves at the opening of the host-free period was undoubtedly effective in reducing the number of flies in the orchards. The temperature from September through December was about 5° F. lower than during the same period of 1932, and this probably aided in retarding to some extent the development of the various stages of the fly. The price of fruit was considerably better than during the preceding year, resulting in much of the crop being harvested early in the season. This, together with the short crop produced, materially reduced the amount of cull or dropped fruit in groves and made possible the maintenance of very effective grove sanitation, thus reducing to a minimum the possibilities of increase from any flies which might have survived the host-free period and spraying operations.

OTHER ANASTREPHA

The operation of traps resulted in the recovery during the year of a number of other species of the fruit-fly genus *Anastrepha* on the Texas side of the Rio Grande, including 97 *A. pallens*, 2 *A. fraterculus*, and 1 *A. serpentina*, in addition to the 6 *A. ludens*. The details are shown in table 8.

The taking of the *Anastrepha serpentina* was of considerable interest since, so far as is known, this was the first specimen of this species of fruit fly ever found in continental United States. The two specimens of *A. fraterculus* were collected in the Harlingen and Weslaco districts. One adult of this species had previously been trapped in the spring of 1932 in the Donna district. No explanation is available to account for the presence of these species in valley groves.

Anastrepha pallens, which is not known to attack commercial fruit, was found in fewer numbers, both in the citrus groves and in *Bumelia angustifolia*, the native host plant, than in the fiscal year 1932.

TABLE 8.—*Infestations of fruit flies in Texas, fiscal year 1933*

Date trapped	District	Adults		Date trapped	District	Adults	
		Males[1]	Females			Males[1]	Females
Jan. 14	McAllen	1		Apr. 3	Harlingen		[2] 1
Jan. 14	Weslaco		[2] 1	Apr. 12	do	1	
Jan. 21	McAllen	1		May 1	Mission	1	
Jan. 24	Weslaco	1		Total		[1] 6	3
Feb. 24	Harlingen		[3] 1				
Mar. 10	do	1					

[1] All 6 males were *Anastrepha ludens;* 43 other specimens of this species were taken in Matamoras, Mexico, as shown in table 11. *Anastrepha pallens* is not known to attack commercial fruit and is therefore omitted from both tables.
[2] *Anastrepha fraterculus.*
[3] *Anastrepha serpentina.*

Also of incidental interest was the taking of an adult papaya fruit fly, *Toxotrypana curvicauda,* in the Weslaco district. This is the second of this species observed in the valley, the first having been taken in this same district during the previous year.

INSPECTIONS

Because of the light crop and curtailed harvesting season the number of grove inspections required during the past year was considerably less than during the preceding season. A total of 30,957 inspections were made; of these it was necessary temporarily to withhold only 740 certificates of inspection, which indicates that groves were kept in excellent condition throughout the harvesting period.

In addition to the regular grove inspections, which were made for the purpose of locating infestations and enforcing sanitary conditions, trapping was carried on throughout the year. During the harvesting period approximately 1,200 fly-traps were operated regularly on the Texas side of the border. This number was increased to about 6,000 during the host-free period.

COLLECTION OF SPECIMENS

Invaluable experience in the most effective methods of inspection was gained by all inspectors during the spring of 1932 when infestations were generally distributed over the valley. Based on this experience, inspections during the last season were confined largely to apparently sound fruit, since experience had shown that larvae of *Anastrepha ludens* were more likely to be found in that class of fruit than in decaying fruit, in which scavenger larvae are most common. For that reason the number of collections and specimens submitted for identification showed a decided decline from the number of the previous year. A total of 3,388 collections were made, comprising 18,349 specimens. Larvae of 10 families of Diptera were commonly encountered in decaying fruit.

ERADICATION MEASURES

It was not deemed necessary or advisable to declare infested zones around the six groves in which adult fruit flies were taken this year. The commercial crop of fruit had been completely harvested in 1 and partly harvested in the other 2 groves in which adults were taken during January. The owners of these groves were notified of the taking of the adult flies, and they immediately completed the harvesting of all remaining commercial fruit and cleaned the trees of all culls. This was followed by a thorough application of the nicotine spray, which was applied under the direct supervision of the district inspectors. There was, of course, no fruit in the groves in which adult flies were found subsequent to March 1. These groves were also given an especially thorough application of the spray during the regular spraying program in the spring of 1933.

HOST-FREE PERIOD

On account of the light crop of fruit produced, there was little or no demand for an extension of the harvesting period, which ended March 1. As in previous years, in order to expedite the work and to make the host-free period effective over as long a period as possible, laborers were employed to examine, under direct supervision of the inspectors, all bearing trees of the valley. The work was particularly difficult this season on account of the unusual amount of "off-bloom" fruit which the trees were carrying. In many of the groves a complete crop of this fruit was present on the trees. This condition was the result of a severe frost in March 1932, when the trees were in full bloom, and the lack of irrigation during the ensuing summer months. It was found that the great majority of growers had made an earnest effort to remove this fruit, but a considerable amount had been overlooked, which it was necessary to have removed by the laborers. This was to be expected in view of the large amount present and the difficulty of distinguishing the green fruit from the leaves. Very little complaint was voiced by the growers on being required to remove the October-bloom fruit, but a number objected strongly to removing fruit which would have ripened in from 4 to 6 weeks.

The tree-to-tree inspection was completed in about 15 days.

ELIMINATION OF ALTERNATE HOST-FRUIT TREES

A total of 308 alternate host-fruit trees were destroyed during the fiscal year. These included 175 guava, 92 peach, 34 plum, 4 pear, and 3 apple trees. The great majority were seedlings which had come up from carelessly tossed out seed. A number of the old trees which the owners had consistently refused to take out died of root rot. A total of 40,293 of such alternate host trees have been voluntarily destroyed by the owners since the quarantine was inaugurated in 1927.

POISON SPRAY

In order to supplement the host-free-period requirement as an eradication measure, arrangements were completed during the last months of the fiscal year 1932 to spray the bearing trees of the quarantined area with a solution of nicotine sulphate and blackstrap molasses. The formula used had been worked out by the Bureau of Entomology, and consisted of 1 gallon of 40-percent nicotine sulphate and 20 gallons of molasses in 179 gallons of water. The first application of this spray was started early in July and was completed in about a month. The poison was applied to 3,645,034 trees on 11,841 premises during the first application. A total of 18,779 gallons of molasses and 940 gallons of nicotine sulphate were required for this application.

The second application was started on August 15. Several changes were made in the methods of distribution of the material which allowed the work to proceed much more rapidly than in the first application. The spraying was completed by the 1st of September, with the exception of a number of groves which were too wet to work. Some 390,000 less trees were sprayed in the second application than in the first. These were young trees in isolated developments which experience had shown were unlikely to be infested. A total of 3,255,480 trees on 11,644 premises were sprayed during the second application. This required 17,053 gallons of molasses and 854 gallons of nicotine sulphate.

A third application of spray was given to the groves which were found infested in the spring of 1932 and the groves adjoining these. This work was conducted by the Texas State Department of Agriculture in the late fall and was completed in January 1933. A total of 106 groves containing 81,631 trees were sprayed. For this work 720 gallons of molasses and 36 gallons of nicotine sulphate were required.

Intensive inspection and the operation of traps resulted in the taking of only six adult fruit flies during the winter and spring months of 1933. This was a marked decrease as compared to the 2,396 specimens collected during the same period of the preceding year. The application of nicotine-molasses spray, started in the summer of 1932, was accordingly continued as an additional eradication measure, and enough material was purchased and forwarded to the valley to allow three applications of the poison spray to the bearing trees in the spring of 1933.

The actual spraying operations of the first application of the 1933 season were started during the last days of March and were completed near the end of April.

There were sprayed, during this application, 4,460,202 trees on 13,867 premises. The material used amounted to 23,520 gallons of molasses and 1,176 gallons of nicotine sulphate. Weather conditions as regards rainfall were ideal throughout and following the application.

The second application was started May 22 and was practically completed by June 21. A number of young trees in isolated locations were omitted in the second application, leaving only 3,875,075 trees on 13,040 premises which were sprayed. In the second application, 21,239 gallons of molasses and 1,060 gallons of nicotine sulphate were used.

Because of the abnormally dry conditions prevailing during the spring and early summer of 1933 when the two applications of spray were made, and since traps operated throughout the valley after May 1 had given negative results, the remaining material was reserved for use in the event that infestations should become established in the future.

Approximately 500 knapsack sprayers were used in applying the poison spray. These sprayers were furnished by the State of Texas and the three counties involved. City governments, civic organizations, and individuals assisted in the work by furnishing labor, storage space, and miscellaneous supplies. Without the excellent cooperation of the industry as a whole, the 100 percent coverage of the producing trees of the quarantined area would have been impossible. Even with the assistance rendered by the various organizations, the absentee-owned and abandoned groves constituted a most difficult problem to handle, and the complete coverage of bearing trees was possible only because of the resourcefulness and ingenuity exhibited by the district inspectors.

Details of the spraying activities are given in table 9.

TABLE 9.—*Summary of spraying operations, fiscal year 1933*

County and application	Properties sprayed			Trees sprayed	Material used	
	Commercial	Noncommercial	Total		Molasses	Nicotine sulphate
Hidalgo:	*Number*	*Number*	*Number*	*Number*	*Gallons*	*Gallons*
First application, July 1932	3,868	2,239	6,107	2,311,769	11,577	580
Second application, August 1932	3,578	2,298	5,876	2,034,125	10,566	528
Third application, April 1933	5,179	2,310	7,489	2,876,981	14,808	740
Fourth application, June 1933	4,446	2,341	6,787	2,521,683	13,468	671
Cameron:						
First application, July 1932	2,585	2,902	5,487	1,286,787	7,016	351
Second application, August 1932	2,579	2,943	5,522	1,176,032	6,309	317
Third application, April 1933	3,164	2,808	5,972	1,498,066	8,269	413
Fourth application, June 1933	2,913	2,746	5,659	1,292,198	7,513	376
Willacy:						
First application, July 1932	149	98	247	46,478	185	9
Second application, August 1932	141	105	246	45,323	178	9
Third application, April 1933	179	227	406	85,155	442	22
Fourth application, June 1933	132	92	224	61,194	258	13
Special application (Hidalgo and Cameron Counties), winter 1932	106		106	81,631	720	36
Total	29,019	21,109	50,128	15,317,422	81,309	4,065

CERTIFICATION OF FRUIT

Several million permit tags are required each season to certify the fruit moving out of the quarantined area. To avoid difficulties in keeping an accurate check on the use of these permit tags, a system of requiring a master permit to accompany each commercial shipment of six or more packages of fruit was instituted at the beginning of the shipping season last fall. These master permits were issued by the inspectors upon exhibition of a bill of sale by the trucker covering the fruit in the load, upon request of the grove owner making the sale, or to cover the movement of fruit from approved packing houses. By this method the inspectors were enabled to identify the groves in which all fruit leaving the quarantined area originated. These permits were issued when the load was ready for shipment regardless of the hour of day or night. Many were issued after office hours and on holidays.

Total shipments equivalent to 4,661 carloads were certified during the season. Approximately 32 percent of this fruit was moved by truck. While the majority of truck shipments went to Texas points and were certified under the State regulations, 1,816 master permits were issued for shipments by road vehicles destined to 24 other States and the District of Columbia. In addition, many out-of-state truckers secured loads of valley fruit in the markets of San Antonio, Dallas, Houston, and other Texas cities.

ROAD TRAFFIC INSPECTION

Traffic-inspection stations were maintained on the two highways leading out of the valley from the first of November to the first of March. As will be seen from table 10, a total of 38,839 vehicles were inspected of which 14,071 were carrying fruit. Of the latter, 1,390 were transporting fruit in violation of the State or Federal regulations. These tourists were given the option of returning the fruit to the valley for proper certification, or of having it destroyed at the stations. Only two complaints were registered during the year by travelers who were required to destroy the fruit they were carrying.

TABLE 10.—*Road traffic inspection, fiscal year 1933*

Month	Total vehicles		Vehicles having properly packed and tagged fruit		Vehicles having contraband fruit		Packages of fruit passed in—		Packages destroyed	Packages returned to area		
	Inspected	Having fruit	Trucks	Passenger autos	Trucks	Passenger autos	Trucks	Passenger autos	Boxes [1]	Boxes	Bushels	Sacks
November	7,025	2,303	1,151	887	[2] 6	[2] 265	121,756	1,634	22¼	------	35	------
December	9,654	4,121	1,917	1,889	[2] 12	312	160,878	4,107	49	2¾	21½	5
January	11,392	4,103	2,072	1,550	1	480	186,706	2,935	60¾	------	25½	------
February	10,768	3,544	1,946	1,284	--------	314	169,002	2,728	44	------	3¾	------
Total	38,839	14,071	7,086	5,610	19	1,371	638,342	11,404	176	2¾	85¾	5

[1] Field box equivalent to 1 bushel.
[2] Part of load O.K.

The ranch roads leading out of the valley to the northwest were patrolled during December. No fruit was observed moving out of the valley by these routes.

CENSUS OF FRUIT TREES

For administrative reasons it is necessary to know the number of trees coming into bearing from year to year over which it will be necessary to maintain supervision. Such information is gathered each spring by the various district inspectors. This census shows that 540,740 citrus trees were planted in orchard form, between April 1, 1932, and March 31, 1933, bringing the total number of citrus trees in the quarantined area to 8,404,740. Of the new trees planted, 427,153, or 79 percent, were grapefruit; 105,291, or 19 percent, were oranges, and 8,296, or 2 percent, were miscellaneous citrus. Of the citrus trees in orchard form 4,813,640, or 57 percent, are of bearing age.

Most of the trees planted during the past year were set out by individuals rather than by development companies as has been the case in previous seasons. Individual growers took advantage of the low price of trees to round out their plantings, while the general economic conditions in the country deterred the land companies from expanding their holdings.

VIOLATIONS

About the usual number of minor infractions of the Federal regulations was encountered during the season, but none of them could be considered willful or deliberate.

Of a more serious nature was the refusal of a number of growers in the Lyford community in Willacy County to clean the ripe and offbloom fruit from their trees at the opening of the host-free period prescribed under State law. The plantings in this community are of the back-yard type from which very little, if

any, fruit is handled commercially. The owners of these trees conceived the idea that the only penalty for allowing the fruit to mature during the summer months would be a refusal of shipping permits, which would be no hardship to them. After persuasive methods had failed, the case was turned over to the State department of agriculture for legal action. The fruit on two of these places was officially condemned as a public nuisance by the commissioner of agriculture and was destroyed by laborers under the protection of the sheriff's office of Willacy County. The owners of the other four premises, on seeing the determined action of the State officers, allowed their fruit to be removed without further objection.

INFESTATIONS IN MATAMOROS, MEXICO

The work of the Mexican Department of Agriculture in suppressing infestations at Matamoros and attempting to prevent the introduction and sale of infested fruits from other parts of the Republic is helping greatly to prevent the reintroduction of the Mexican fruit fly into the citrus-growing area on the Texas side of the border.

All citrus and other fruits arriving in Matamoros from interior points are inspected on arrival before being released to the consignees. Following such release, all fruit that shows signs of decay or infestation is collected daily from the markets and after inspection is destroyed by burning. Inspection of fruit on arrival in Matamoros and of that spoiling in the markets resulted in the finding of 6,654 larvae and 33 pupae during the year. These specimens were taken from apples, guavas, mangoes, oranges, quinces, and from the box used in transporting spoiled fruit from the market to the office of the Mexican inspector. As in previous years, mangoes were found to carry the heaviest infestation of any fruit reaching Matamoros. Some wormy fruit is undoubtedly sold to the citizens before any external evidence of infestation is apparent. When the purchaser later finds this fruit wormy, it is, in many instances, thrown out in the patio, which accounts for the continued taking of adult fruit flies in Matamoros.

Approximately 200 flytraps were operated continuously during the year in Matamoros. These traps captured 43 adult fruit flies on 12 premises. This was about half the number taken during the preceding year.

As a result of these activities, the development of local infestation in Matamoros is largely prevented. Only three such local infestations were discovered during the year. These were found in July and October 1932, and April 1933, respectively. The facts indicated that a single female, in all probability, was responsible for each of these infestations, these females having evidently escaped the traps and poison spray until after they had laid eggs.

TABLE 11.—*Infestations of Anastrepha ludens in Matamoros, Tamaulipas, Mexico, fiscal year 1933*

Month	Local fruit			Imported fruit							Total
	Adults trapped	Larvae found in—		Larvae found in—						Pupae in mango	
		Orange, sour	Sargentia	Apple	Guava	Mango	Orange	Quince	Unknown[1]		
July	2	169				37	6				214
August	1			[2] 1			1	[2] 6			9
September				4			21	2	2		29
October	22	5									27
November	3						3				6
December							67				67
January							3				3
February					[3] 9	15					24
March	1					58	1				60
April	11					337	6				354
May			11			891	3				905
June	3					5,181				33	5,217
Total	43	174	11	5	9	6,519	111	8	2	33	[4] 6,915

[1] Specimens taken from box in which fruit was carried from market to office.
[2] Anastrepha species—not typical *A. ludens*.
[3] Probably *A. striata*.
[4] 2,521 of these specimens were forwarded to Mexico City for identification.

Eradication measures were promptly undertaken not only with respect to the three instances in which larval fruit flies were captured in local fruit but also in every case in which adult fruit flies were caught in the traps. All fruit trees within the four blocks surrounding each of the infested premises were sprayed with the same materials used in the case of similar outbreaks in the Texas area. In addition, two city-wide applications of the spray were made subsequent to the arrival of shipments of heavily infested fruits on the markets. Following the finding of larval infestations all fruit was stripped from the trees on the infested premises and, after being carefully examined, was destroyed by burial. The trees on these premises were given an additional application of the spray. Infestations did not develop to an extent necessitating a city-wide host-free period.

The careful and systematic collection and destruction of infested fruit reaching the city from the interior of Mexico reduce to a considerable extent the chances of an infestation's becoming established. This risk is still further reduced by the operations of the flytraps, in which many adult flies are caught before their eggs have had an opportunity to develop.

The fruit-fly findings in Matamoros are shown in detail in table 11.

DATE-SCALE ERADICATION

Systematic inspection was continued in the date-growing areas of Arizona and California. Careful scouting for unlisted palms was also continued. Several small abandoned date plantings of no value were dug out and destroyed, and previously cleaned acreage was checked for volunteer plants and parts of stumps. The details are given in table 12.

COACHELLA VALLEY

During the past year 123,759 palm inspections were made in the Coachella Valley. No Parlatoria scale was found. This is the first year since the beginning of the project that scale has not been found, and is the second successive year in which no new infestation has been discovered. There were dug out and destroyed during the year 775 date palms of no value, many of which had previously been infested, and 219 previously infested palms were stripped of fiber to examine the leaf bases for scale.

TABLE 12.—*Palm inspection and treatment, date-scale eradication project, fiscal year 1933*

Item	Arizona		California		Total
	Phoenix district	Yuma district	Coachella Valley district	Imperial Valley district	
Palm inspections	41,242	2,376	123,759	43,347	210,724
New infested properties	0	0	0	0	0
Total infested properties	1	0	0	4	5
Date palms infested	1	0	0	2	3
Canary Island palms infested	0	0	0	5	5
Total	1	0	0	7	8
Treatment:					
Dug out and destroyed	1	0	0	1	2
Defoliated and sprayed	0	0	0	6	6
Total	1	0	0	7	8
Valueless palms dug out in infested areas; not included above	0	0	775	95	870

IMPERIAL VALLEY

In the Imperial Valley, 43,347 palm inspections were made during the year. Two infested date palms were found on 2 properties—both old infestations—as compared with 14 infested date palms on 7 properties—4 old and 3 new infestations—found during the fiscal year 1932. In addition to the 2 infested date palms found in the fiscal year 1933, 5 Canary Island palms were found infested

as compared with 33 Canary Island and 10 fan palms found infested in 1932. A total of 7 infested palms was thus found on 4 properties in this valley in 1933, as compared with 57 infested palms on 11 properties in 1932. Six new infestations were found in 1932, and none in 1933. Careful scouting was carried on in 233 sections to locate unlisted palms. A number of small date palms, one infested, noted above, were discovered. Ninety-five date palms on infested properties were dug out and destroyed.

PHOENIX DISTRICT

In the Salt River Valley of Arizona, 41,242 palm inspections were made and 1 infested palm was found on a previously infested property. The palm was dug out and destroyed. This is the only infested palm found in Arizona during the past 2 years. Scouting for unlisted palms was continued and 413¼ sections covered.

YUMA DISTRICT

In the city of Yuma and vicinity, 2,376 palm inspections were made and no scale found.

MODIFICATION OF QUARANTINE

Effective December 1, 1932, the quarantine was amended by removing the Phoenicococcus scale (*Phoenicococcus marlatti*) from consideration, as it was found that this insect is not serious commercially. Evidence of freedom from the Parlatoria scale now constitutes the basis for issuing Federal permits for the shipment or transportation of date palms or date-palm offshoots from the regulated areas; namely, Imperial County and that part of Riverside County lying east of the San Bernardino meridian in California; Yuma, Maricopa, and Pinal Counties in Arizona; and Webb County in Texas.

QUARANTINE ON DOMESTIC NARCISSUS

During the past year, special attention has been given to increasing the efficiency of bulb inspection and treatment methods. Under a reorganized plan of cooperation with the Bureaus of Plant Industry and Entomology, progress was made in the development of the vapor-heat treatment, and on June 26, 1933, that method was authorized as a basis for narcissus treatment to eliminate greater bulb flies. Vapor heat has also been found very effective as an eelworm control, and experiments are now being carried on to determine whether it can be relied on to eliminate the nematodes entirely, without injuring the bulbs.

Difficulties in obtaining satisfactory results from the hot-water treatment have also been the subject of investigation, and certain modifications in tank design and equipment have been devised to increase the agitation of the water and thereby bring about a higher eelworm mortality through better heat distribution.

The treatment and inspection instructions issued in June 1932 have been consistently adopted by the State inspectors carrying out the field and warehouse bulb examinations, and this has increased uniformity of action in the different bulb-growing areas. A number of conferences were held with growers and inspectors in nearly all the leading narcissus-producing sections during the year, and differences in methods and interpretations were cleared up. Among other questions, the problem of handling large blocks of bulbs which show very slight and recent eelworm infestations was intensively studied, and instructions have been issued specifying the conditions under which parts of some such blocks may be certified as free from infestation.

For the season of 1932 the State nursery inspectors of the various States reported to the Bureau the inspection of 302,323,265 narcissus bulbs grown in 29 States and the District of Columbia. This represents a decrease of 71,942,429 bulbs under the figures for the previous year. Of the total, 169,815,503 consisted of Paper White and other polyanthus types of bulbs grown in the Southern States, and 132,507,762 consisted of bulbs of the hardy daffodil types grown in the North. Of the polyanthus types, 148,736,581 were reported as being certified as uninfested and eligible for shipment without treatment, while 2,188,109 were either fumigated or given the hot-water treatment and certified for shipment on that basis. Of the daffodil types, 19,629,551 were certified as uninfested, and shipment without treatment was authorized, and 84,580,213 were either fumigated or given the hot-water treatment, and certified on that basis.

Infestations with eelworms (*Tylenchus dipsaci*) were reported in 1932 in one or more plantings in California, Florida, Georgia, Maryland, Michigan, Missouri, New Jersey, New York, North Carolina, Ohio, Oregon, Tennessee, Virginia, and Washington. In addition to the records for 1932, this species had previously been reported in narcissus plantings in Alabama, Illinois, Indiana, Kansas, Kentucky, Mississippi, Rhode Island, Utah, and Wisconsin. Some of these plantings have not since been reported as inspected, and infestation may possibly be persisting in them.

Greater bulb flies (*Merodon equestris*) were reported in California, Michigan, New York, North Carolina, Oregon, Pennsylvania, Rhode Island, Virginia, and Washington. They have also been reported in previous years in narcissus plantings in Illinois, Ohio, and Utah.

The lesser bulb flies (*Eumerus* spp.) were removed from consideration under the Federal narcissus-bulb quarantine in an amendment which became effective on June 20, 1932. Accordingly, most of the State inspectors did not report the presence or absence of the lesser flies in 1932.

Detailed information on the numbers of plantings and bulbs and the extent of treatment in the individual States and the District of Columbia is given in Circular B.P.Q.—349, issued on February 17, 1933.

BLACK-STEM RUST QUARANTINE

The quarantine on account of black-stem rust (*Puccinia graminis*), under which Federal permits are required for all shipments of barberry and mahonia plants (except *Berberis thunbergii* and its rust-immune varieties) consigned into or between 13 of the North Central States, is designed to assist those States in protecting grain from black-stem rust infection.

In cooperation with the Bureau of Plant Industry, the premises of some 30 applicants for permits were inspected, and permits were issued to 25 firms, an increase of 5 over the previous year. Sixteen violations of this quarantine were intercepted at transit-inspection points during the year.

According to the Bureau of Plant Industry, the protected States, which have been engaged for a number of years in a barberry-eradication campaign, destroyed in cooperation with that Bureau 175,951 barberry bushes, seedlings, and sprouts during the calendar year 1932, making a total of 18,665,403 since the campaign was started in the spring of 1918. The States in which this work is being carried on are Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin, and Wyoming.

PHONY-PEACH DISEASE QUARANTINE REVOKED

The phony-peach disease quarantine was revoked, effective March 1, 1933. When the quarantine was placed by the Department, effective June 1, 1929, it was believed as a result of surveys in 1926, 1927, and 1928, that the disease was confined to the States of Georgia and Alabama, although it was known to have been present in Georgia for some 50 years. Surveys during the next 2 years disclosed infections in Mississippi, Texas, Arkansas, Louisiana, Tennessee, North Carolina, and South Carolina. Surveys in 1931 showed further infections in Florida and Illinois. During 1932, infected trees were found in southern Oklahoma and in southeast Missouri. Scattered infections were also found during the year in new localities in Arkansas, Illinois, and Texas.

The widely separated infections in some of the States concerned have made the enforcement of intrastate quarantine regulations by these States impracticable, thereby complicating the problem of maintaining Federal control of interstate shipments, and this condition indicated that further control of spread could be handled more satisfactorily by improved and modified nursery-inspection methods in the various States than by enforcement of the type of Federal quarantine regulations previously in effect.

The investigations of the Bureau of Plant Industry point so strongly to the peach borer as the carrier of the disease, that the future activities of this Bureau with respect to phony-peach-disease control will be confined largely, insofar as funds and facilities permit, to assisting the States in the development and adoption of improved culling practices to eliminate all peach-borer infested or injured stock, and increasing the efficiency of inspection in peach-growing nurseries and the environs by directly aiding in such surveys.

The States of Arkansas, Delaware, Georgia, Mississippi, and Oklahoma promulgated State regulations directed against this disease after the Federal quarantine was taken off. Other interested States are handling the problem of prevent-

ing the spread of infection by administratively controlling it through the usual nursery-inspection organization in cooperation with this Bureau. Federal aid in bringing about the eradication of the disease is under the direction of the Bureau of Plant Industry.

Table 13 shows that 19 shipments moving in violation of the phony-peach disease quarantine were intercepted between July 1, 1932, and March 1, 1933, the date on which the quarantine was revoked.

WOODGATE-RUST QUARANTINE

The Woodgate-rust quarantine, which has been in effect since November 1928, was issued for the purpose of preventing the spread of the Woodgate rust, a disease which attacks Scotch and other hard pines. No spread of the disease, outside the present regulated area comprising the counties of Clinton, Essex, Franklin, Hamilton, Herkimer, Jefferson, Lewis, Madison, Oneida, and St. Lawrence, N.Y., was reported, and no violations of the quarantine were intercepted during the fiscal year.

WHITE-PINE-BLISTER-RUST QUARANTINE ENFORCEMENT

A revision of the quarantine regulations on account of the white-pine blister rust (*Cronartium ribicola* Fischer) effective January 1, 1933, greatly extended the area into which protected white pines might be shipped from the infected States. Prior to 1928, it was necessary to rely largely on embargoes prohibiting the shipment of blister-rust host plants from generally infected areas to other sections of the country. For several years since that time, the protection of five-leafed pine nursery stock by eliminating currant and gooseberry plants (*Ribes*) in the vicinity has been tried out in a limited way. Under the new revision, the general principle of growing five-leafed pine for interstate movement under such protected conditions has been extended and the shipment of such protected pine to noninfected States has been authorized.

This change was based (1) on increasing evidence of the effectiveness and practicability of Ribes eradication for the protection of nursery stock, and (2) on the discovery that the natural spread of the disease had carried it from 16 Northern States where it had been known for some time to 5 additional adjoining States.

The newly infected States which it was necessary to add in this revision of the regulations are Iowa, Maryland, Ohio, Virginia, and West Virginia. In each of the States named blister rust was found at only a few points, and the infections were light. The District of Columbia is also classed as infected because of its location between Maryland and Virginia, although the blister rust has not yet appeared within the District limits. The rust was discovered in most cases only on wild currant or gooseberry plants or on European black currants in gardens, having reached the new localities apparently by wind spread from infected pines in adjoining States.

The new regulations greatly extend the market for white pines and other five-leafed pines grown under protected conditions, by authorizing their movement under permit throughout the United States or into such States as may be specified in the permit.

For all or parts of the shipping season of 1932–33, permits were in effect covering 10 nurseries in the infected States, and 2 additional seed beds were covered by tentative permits, the environs being subject to reinspection before the pines would be old enough to ship. At the close of the fiscal year inspections of the premises and environs of 38 nurseries were under way to determine whether they were entitled to permits for the coming fall and spring. The premises of many applicants have been found not to comply with the requirements in full, and it has not been possible to issue permits to the owners of the nurseries involved.

The revision also simplified the interstate shipment of currant and gooseberry plants from the infected States. Hereafter, such plants will not be required to be disinfected in lime-sulphur, unless shipped with active buds.

During the year 107 shipments of five-leafed pines or *Ribes* were intercepted as moving in violation of the blister-rust quarantine regulations.

TRANSIT INSPECTION

Transit inspection consists of checking shipments of plants moving by mail, express, and freight, to determine whether they have met the safeguards required under domestic plant quarantines.

Such quarantines can prevent the transportation of serious pests into new localities only if infested products are prevented from being shipped from the quarantined districts to outside points. Such infestations may be carried to new areas by those ignorant of, or indifferent to, the required safeguards. The transit inspectors work in important post offices and at express and freight transfer points through which quarantined products move, and, on discovering uncertified shipments which may carry infestation, return them to the sender.

This work is particularly necessary when new areas or new products are brought under quarantine. In such cases, interested shippers cannot all be reached or their indifference overcome, until a check is made on the movement of the plants or other products concerned. The Department has found that when such checking is not carried out a considerable proportion of plant shipments are sent without having been inspected or having complied with the safeguards needed to prevent the spread of infestation. With transit inspection in operation, however, the number of quarantine violations is reduced to 1 or 2 shipments in every thousand, and these are intercepted and turned back. For example, western Pennsylvania was brought within the area regulated under the Japanese-beetle quarantine in the fall of 1932, but checking on common-carrier shipments was not started until May 20, 1933. Thirty-four shipments moving in violation of the Federal and State quarantines on account of this pest were intercepted during the first 8 days of such checking. Within the next 2 weeks thereafter shippers had so familiarized themselves with the requirements that the number of violations was reduced to less than one a day.

The return of the plants to the sender under such conditions is proving a much more desirable procedure than prosecuting the shipper. Since this project was organized several years ago, prosecutions have been instituted only in the case of apparently intentional violations or where gross carelessness was involved.

The most important change in the project during the year consisted of the establishment of transit inspection at Jacksonville, Fla., in August 1932, in cooperation with the State plant board. The number of interceptions reported immediately showed the importance of this point for the protection of the State against the introduction of the Japanese beetle and other pests, as well as for the enforcement of the narcissus-bulb quarantine.

The number of violations intercepted at the various inspection points during the fiscal year 1933 totaled 1,486, out of 873,153 shipments, 625 carloads, and 1,276 trucks checked. A synopsis of the work is given in tables 13 and 14. The information given in table 13 includes interceptions of this type made by inspectors employed on other projects working in direct cooperation with transit inspectors but does not include reports from State inspectors at points of destination, except in the case of Florida where, as stated, the work is carried on in direct cooperation with the Department. The numbers of shipments inspected and of interceptions, respectively, are lower than during the past several years, partly on account of reductions in the number of inspectors owing to reduced appropriations, and partly on account of lessened total traffic in plants resulting from the depressed economic conditions throughout the country.

12988—33——5

TABLE 13.—*Summary of shipments of nursery stock and other articles intercepted in violation of Federal plant quarantines*[1] *at transit inspection points, fiscal year 1933*

Station	Number of shipments intercepted in violation of quarantine—																		
	No. 38		No. 43, C	No. 45		No. 48		No. 53, NC	No. 62		No. 63		No. 64		No. 67		Total		Grand total
	C	NC		C	NC	C	NC		C	NC	C	NC	C	NC	C	NC	C	NC	
Albany						1	1										1	1	2
Atlanta							2			1					4	2	4	5	9
Boston				68	96	93	84	3	4		4	7		1			169	191	360
Chattanooga															2		2		2
Chicago	1	1	1	2	11	13	32	2	10	16	35	11		1			62	74	136
Dallas															2		2		2
Jacksonville					5	15	56	2	22	10						2	37	75	112
Jersey City						7	1		1								8	1	9
Kansas City					1	3	7		8		8	3					19	11	30
Long Island City						10											10		10
Milwaukee						1											1		1
Nashville															2		2		2
New York			1	32	44	121	153	5	36	8	1	7					191	217	408
Omaha					1	2	10		2	5	6		1	2			11	18	29
Philadelphia				6	6	124	67		5	1	5	1					140	75	215
Pittsburgh				1		19	12			1	1						21	13	34
Portland		1							7	6	5	2					12	9	21
St. Louis							1				1						1	1	2
St. Paul and Minneapolis						1	4		3	1		3		2			4	10	14
Salisbury							1								3		3	1	4
Seattle		11								6		4						21	21
Shreveport, La															1		1		1
Spokane	1	1				1	3	1	12	6	1	1					15	12	27
Sunnyside, N.Y						1											1		1
Texarkana					1			1							1		1	2	3
Washington				1	1	7	15		5	1	1						14	17	31
Total	2	14	2	110	166	419	449	14	115	62	68	39	1	6	15	4	732	754	[2] 1,486

[1] Quarantine No. 38 relates to black stem rust; no. 43, to the European corn borer; no. 45, to the gypsy moth and brown-tail moth; no. 48, to the Japanese beetle; no. 53, to the satin moth; no. 62, to narcissus pests; no. 63, to the white pine blister rust; no. 64, to the Mexican fruit worm; and no. 67, to the phony peach disease. C indicates packages sent by commercial shippers; NC, shipments by those not commercially engaged in the business to which the quarantine relates.

[2] The total number of quarantine violations represents 1,423 shipments, of which 59 were in violation of 2 quarantines, and 2 were in violation of 3 quarantines.

TABLE 14.—*Shipments of nursery stock and other plants and plant products inspected in transit during the fiscal year 1933*

Station	Packages				Carloads of nursery stock and livestock cars	Trucks
	Parcel post	Express	Freight	Total		
Albany	963	333	28	1,324		
Atlanta	2,166	2,940	490	5,596	1	
Boston	23,041	38,400	80	61,521	18	
Chattanooga		269	69	338		
Chicago	117,229	23,087	1,896	142,212	111	1,276
Dallas	1,045	2,577	17	3,639		
Jacksonville	11,007	19,578	12,063	42,648	198	
Kansas City	35,133	9,079		44,212		
Memphis	794	1,642	306	2,742		
Meridian		107	13	120		
Milwaukee	74	8		82		
Nashville	192	406	271	869		
New York	116,429	21,803	1,381	139,613	61	
Omaha	19,871	3,929	1,935	25,735		
Philadelphia	150,063	62,969	1,256	214,288	198	
Pittsburgh	25,093	6,600	243	31,936		
Portland	18,292	7,132	2,364	27,788		
St. Louis	2,009	1,816		3,825		
St. Paul	28,978	6,338	8,310	43,626	23	
Salisbury and Spencer, N.C	125	667	516	1,308		
Seattle	18,512	3,704	288	22,504		
Shreveport, La		230	7	237		
Spokane	32,723	2,893	810	36,426		
Texarkana	364	2,972	107	3,443	1	
Washington	4,747	10,038	2,336	17,121	15	
Total	608,850	229,517	34,786	873,153	626	1,276

In addition to the figures given in table 13, the transit inspectors intercepted 141 shipments moving intrastate in violation of State quarantines relating to pests covered by Federal quarantines and enforced by the States concerned in cooperation with this Bureau.

FOREIGN PLANT QUARANTINES

The 22 foreign plant quarantines and regulatory orders of the Department prohibiting or restricting the entry of various plants and plant products into the United States are enforced through the Division of Foreign Plant Quarantines by inspectors and collaborators stationed at the more important ports of entry and foreign-mail distributing points, and working in close cooperation with employees of other Government departments. Detailed information on these quarantines and orders is available in other publications and is therefore omitted.

In succeeding sections explanations of enforcement activities in connection with these quarantines and orders are given in more detail and are accompanied by tables presenting in condensed form records which indicate the scope of the work or which summarize its results.

RECORDS OF IMPORTS OF RESTRICTED PLANTS AND PLANT PRODUCTS

Under the various foreign quarantines certain plants and plant products are restricted as to entry, are subject to inspection and, if necessary, disinfection, for the purpose of excluding plant diseases and insect pests. Among such restricted plants and plant products are nursery stock, plants, bulbs, and seeds; fruits and vegetables; grains from certain countries; cotton, cotton waste, cotton wrappings (bagging), and cottonseed products; also cottonseed, seed cotton, and cottonseed hulls from the Imperial Valley, Lower California, Mexico. A record of the importation of the products inspected by inspectors of the Bureau and, if necessary, treated under their supervision, is given.

IMPORTATIONS OF NURSERY STOCK, PLANTS, BULBS, AND SEEDS

The importations recorded in tables 15 to 18, inclusive, are entered under regulation 3 of Quarantine No. 37, under permits that are valid until revoked and that do not limit the quantity that may be imported. The restrictions under this regulation are intended merely to afford opportunity to inspect and, if necessary, to safeguard the products as they are entered. Table 15 records the number of importations of fruit and nut cuttings and scions and rose stocks inspected and, if necessary, safeguarded, during the fiscal year 1933. This table also shows the total number of such importations similarly handled during the fiscal year 1932. A record of certain bulbs entered under permit subject to inspection and treatment is furnished in table 16. Table 17 records the number of various kinds of bulbs entered under permit for each of the past 8 years. Table 18 shows the number of pounds of tree seeds imported under permit for the fiscal year 1933 and the countries of origin of such seeds.

In addition to the foregoing there were imported from Canada under regulation 15, Quarantine No. 37, 119,990 bulbs, plants, trees, and cuttings, as compared with 190,408 during the fiscal year 1932. To authorize the importation of this material 696 permits were issued during the fiscal year 1933, as compared with 605 issued during the fiscal year 1932.

The record of entry under special permits issued under the provisions of regulation 14 of Quarantine No. 37 for the purpose of keeping the country supplied with new, improved, or unavailable varieties and necessary propagating stock and for experimental, educational, or scientific purposes is given in table 19.

TABLE 15.—*Importation of fruit and nut cuttings and scions, and of rose stocks under regulation 3, Quarantine No. 37, from countries indicated, fiscal year 1933*

[Figures indicate number of plants]

Kind of stocks, cuttings, and scions	Austria	Canada	Czechoslovakia	England	France	Germany	Greece	Hungary	Italy	Lithuania	Netherlands	Poland	Rumania	Scotland	Total	
															1933	1932
Cuttings and scions:																
Apple		287	15	96						108		16			522	305
Apricot																12
Avocado																66
Cherry	24					16									40	120
Fig									561						561	119
Grape			2		50		15	35	2,250		12		4,266		6,630	1,288
Medlar																1
Nut																122
Peach	23														23	
Pear	26		15												41	48
Pineapple																700
Plum	21			80		11			23						135	46
Prune																19
Rose stocks				474,900	205,000	15,000			7		5,733,475			25,000	6,453,382	9,522,296
Total	94	287	32	475,076	205,050	15,027	15	35	2,841	108	5,733,487	16	4,266	25,000	6,461,334	9,525,142

TABLE 16.—*Importation of bulbs under regulation 3, Quarantine No. 37, from countries indicated, fiscal year 1933*

[Figures indicate number of bulbs]

Bulbs	Australia	Bermuda	Canada	China	Czechoslovakia	England	France	Germany	India	Ireland	Italy	Japan	Manchuria	Netherlands	New Zealand	Palestine	Philippine Islands	Scotland	Switzerland	Union of South Africa	Total
Chionodoxa						100				24				416, 123							416, 247
Convallaria					60	24		9, 525, 205						667, 145							10, 192, 434
Crocus						670		10		256				7, 001, 876		5		16			7, 002, 833
Eranthis						24								144, 995							145, 019
Fritillaria						100						10		128, 519							128, 629
Galanthus						5, 300	73, 400			23				566, 493							645, 216
Hyacinth	7	500				149	301, 543							16, 370, 604							16, 672, 803
Ixia							12							114, 771	15					12	114, 810
Lily	6	[1] 418, 989	133			1, 531	638, 506	30	844	10	56	[2] 13, 815, 629	100	320, 260			12	12			15, 196, 118
Muscari														934, 073							934, 073
Narcissus [3]				14, 820																	14, 820
Scilla						1, 084	1							1, 252, 987		7		100	2		1, 254, 181
Tulip			181	150		694	86, 475	215				2, 002		92, 665, 321				224			92, 755, 262
Total	13	419, 489	314	14, 970	60	9, 676	1, 099, 937	9, 525, 460	844	313	56	13, 817, 641	100	120, 583, 167	15	12	12	352	2	12	145, 472, 445

[1] Includes 12 lily bulbs imported into Puerto Rico from Bermuda.
[2] Includes 1,885 lily bulbs imported into Hawaii from Japan.
[3] The order of the Acting Secretary of Agriculture of Oct. 31, 1928, authorizes the importation of the Chinese sacred lily (*Narcissus tazetta* var. *orientalis*) into Hawaii for local use and distribution under permit and subject to inspection, under the provisions of regulation 3 of Quarantine No. 37.

TABLE 17.—*Summary of bulb importations under regulation 3, Quarantine No. 37, for fiscal years 1926–33*

[Figures indicate number of bulbs]

Bulbs	1926	1927	1928	1929	1930	1931	1932	1933
Chionodoxa	839,637	466,872	439,075	487,228	476,422	548,465	518,885	416,247
Convallaria	20,543,785	20,558,460	24,738,880	23,087,167	23,661,236	17,273,064	16,015,817	10,192,434
Crocus	10,898,968	9,969,070	8,775,467	9,886,546	8,075,439	9,033,346	8,801,592	7,002,833
Eranthis	214,173	144,150	135,842	143,592	188,611	186,516	186,630	145,019
Fritillaria	209,543	125,688	111,778	115,658	122,699	166,174	137,052	128,629
Galanthus	1,128,335	844,544	662,989	718,130	751,523	918,613	800,922	645,216
Hyacinth	23,682,560	23,711,178	22,127,888	21,450,547	20,255,057	21,759,225	19,360,849	16,672,803
Ixia	545,278	529,404	704,644	827,154	461,252	368,982	326,790	114,810
Lily	16,031,090	16,228,762	19,917,477	21,453,024	20,737,428	19,561,911	17,370,254	[1] 15,196,118
Muscari	1,404,573	993,339	1,150,220	1,639,982	1,473,455	1,523,243	1,361,018	934,073
Narcissus	142,384,199	[2]	[2]	[2]	[2]	[2]	17,880	[1] 14,820
Scilla	2,012,750	1,553,313	1,341,685	1,436,988	1,544,889	1,699,123	1,618,579	1,254,181
Tulip	106,849,572	129,681,036	161,940,818	191,959,162	163,604,912	153,868,063	125,381,713	92,755,262
Unclassified		11,112						
Total	326,744,463	204,816,928	242,046,763	273,205,178	241,352,923	226,906,725	191,897,981	145,472,445

[1] This table includes 1,885 lily bulbs and 14,820 *Narcissus tazetta* imported into Hawaii and 12 lily bulbs imported into Puerto Rico in the fiscal year 1933.
[2] Imported under regulation 14, Quarantine No. 37, since Jan. 1, 1926.

TABLE 18.—*Importation of tree seeds under regulation 3, Quarantine No. 37, from countries indicated, fiscal year 1933*

[Figures indicate number of pounds]

Country of origin	Apple	Apricot	Banana	Cherry	Elm	Nut and palm	Ornamental and tree	Peach	Pear	Persimmon	Plum	Quince	Rose	Miscellaneous	Total
Australia						11,886	27	1						6	11,920
Argentina														2	2
Austria	565			1		5	15,201		7				2		15,781
Azores							5								5
Belgian Congo						2									2
Brazil						102	1								103
British Guiana						5									5
Canada							5,737								5,737
Canal Zone						1	2							1	4
Ceylon							6							1	7
China					258	143	21							6	428
Costa Rica							1								1

TABLE 18.—*Importation of tree seeds under regulation 3, Quarantine No. 37, from countries indicated, fiscal year 1933*—Continued

Country of origin	Apple	Apricot	Banana	Cherry	Elm	Nut and palm	Ornamental and tree	Peach	Pear	Persimmon	Plum	Quince	Rose	Miscellaneous	Total
Cuba						5	4							2	11
Czechoslovakia							308								308
Denmark							50								50
England							9								9
France	3,481	5	1	1,911		38	393		126			25			5,980
Germany	11			9		3	3,316		3		2		47		3,391
Gold Coast							1								1
Greece							2								2
Guatemala						1	1				1				3
India							11								11
Italy						226	6,305			10					6,541
Jamaica						2								1	3
Japan				50	25	345	3,188		373	6			293	2	4,282
Java						1	1								2
Manchuria					116		150							1	267
Mauritius						13									13
Mexico							10							2	12
Netherlands							1								1
New Zealand							509								509
Nicaragua						5	13								18
Palestine							4								4
Panama														1	1
Peru							1								1
Philippine Islands						1	2							2	5
Poland							13								13
Salvador														4	4
Scotland							146								146
Sierra Leone							11								11
Straits Settlements						5									5
Sudan							2								2
Tanganyika Territory														1	1
Trinidad						260	2								262
Uganda						6									6
Union of South Africa						10	9								19
Virgin Islands						1									1
Total[1]	4,057	5	1	1,971	399	13,066	35,463	1	509	16	3	25	342	32	55,890

[1] In addition to the seeds indicated, 417 small mail packages of miscellaneous seeds were imported into the continental United States from various countries; also the following were imported into Puerto Rico: 1 package of nut and palm seeds from Ceylon; 798 pounds of seeds of ornamentals and trees from Guadeloupe, Panama, St. Croix, and Venezuela; and into Hawaii the following: 2 packages and 2,556 pounds of nut and palm seeds, 32 packages and 103 pounds of seeds of ornamental and tree seeds, 3 packages of persimmon seeds, and 1 package of rose seeds from American Samoa, Argentina, Australia, Brazil, Ceylon, China, Cuba, Fiji, France, Germany, Guatemala, India, Japan, Makatea Island, Marshall Islands, Mexico, New Zealand, Philippine Islands, Straits Settlements, Sumatra, Tahiti, and the Union of South Africa.

TABLE 19.—*Special-permit importations, fiscal year 1933, with combined total for fiscal years 1920–33*

Class of plants	Fiscal year 1933				Total for fiscal years 1920–33 [1]			
	Permits issued		Importations under permits		Permits issued		Importations under permits	
	Number	Quantity authorized	Number	Quantity imported	Number	Quantity authorized	Number	Quantity imported
Dahlia	71	2,156	62	1,859	843	58,381	724	42,283
Gladiolus	109	111,197	99	85,812	1,989	50,803,171	1,683	28,730,627
Iris, bulbous	56	1,137,883	91	1,794,589	1,591	53,627,689	1,372	39,193,464
Iris, rhizomatous	49	1,325	47	1,206	1,566	293,662	1,380	158,861
Narcissus	70	220,674	79	1,076,356	1,401	163,079,733	1,176	79,220,053
Orchid	195	15,148	169	11,526	2,115	244,445	1,891	189,368
Peony	29	1,387	33	1,342	1,259	1,399,089	1,043	684,842
Rose	82	5,290	82	4,675	1,453	270,988	1,295	192,728
Fruit (trees and small fruits)	16	955	14	696	227	20,816	163	10,179
Herbaceous	87	29,404	159	34,446	1,719	4,870,979	1,382	3,045,034
Miscellaneous bulbs, roots, etc.	128	85,208	122	67,643	1,907	13,029,492	1,663	6,829,297
Ornamental	344	57,766	302	48,144	2,561	3,993,023	2,268	2,295,929
Total	------	1,668,393	------	3,128,294	------	291,691,468	------	160,592,665

[1] Complete totals for Hawaii included for the first time. Previous reports carried Hawaiian totals for 1931 and 1932 only.

NOTE.—The disparity in the number of bulbs, plants, etc., imported, as compared with the number authorized entry, may be explained by the fact that permits for some classes of plants, particularly narcissus and bulbous iris, are usually issued during 1 fiscal year and the importations made during the following fiscal year.

During the year 1,145 permits were issued authorizing the entry of 1,668,393 plants, bulbs, etc. A total of 3,128,294 plants, bulbs, etc., were imported under 1,074 permits, as compared with 3,547,552 in 1932. While it would appear that more plant material has been imported than was authorized entry, this disparity is explained in the note following table 19. Importations of narcissus were 562,830 bulbs less, and those of bulbous iris 153,089 bulbs more than in 1932. Small increases in quantities imported are recorded for dahlias, gladiolus, and ornamentals, while the total importations of rhizomatous iris, orchids, peonies, roses, fruits (trees and small fruits), herbaceous, and miscellaneous bulbs, roots, etc., were less than for these classes of plants in 1932. The greatest rate of increase in importations occurred in gladiolus, and the heaviest rate of decrease is noted in rhizomatous iris. A comparison of the records shows an increasing use of the mails for these importations. In 1933, 71 percent of the importations were authorized to come forward by mail as compared with the 60 percent so authorized in 1932. A summary of special permits issued during the entire period of the quarantine to date is given in table 20.

TABLE 20.—*Special-permit importations, yearly totals for fiscal years 1920–33* [1]

Fiscal year	Permits issued		Importations under permits		Fiscal year	Permits issued		Importations under permits	
	Number	Quantity authorized	Number	Quantity imported		Number	Quantity authorized	Number	Quantity imported
1920	311	10,752,844	171	3,484,195	1928	1,638	37,955,017	1,386	24,645,001
1921	623	13,965,113	411	8,132,634	1929	1,389	16,981,012	1,377	17,972,441
1922	751	9,573,223	519	3,344,050	1930	1,343	11,219,533	1,102	2,073,116
1923	902	15,176,718	723	10,358,921	1931	1,418	8,230,924	1,300	10,121,457
1924	1,115	15,381,913	869	12,561,574	1932	1,306	6,276,579	1,195	3,547,552
1925	1,249	9,518,620	1,099	8,575,741	1933	1,145	1,668,393	1,074	3,128,294
1926	1,465	80,983,487	1,220	6,022,041					
1927	1,480	54,008,092	1,279	46,625,648	Total	16,135	291,691,468	13,725	160,592,665

[1] Complete totals for Hawaii included for the first time. Previous reports carried Hawaiian totals for 1931 and 1932 only.

NOTE.—The disparity in the number of bulbs, plants, etc., imported, as compared with the number authorized entry, may be explained by the fact that permits for some classes of plants, particularly narcissus and bulbous iris, are usually issued during one fiscal year and the importations made during the following fiscal year.

The number of varieties considered has now reached a total of 62,570 (an increase of 3,242 during the year), of which 60,214 have been approved for entry. Table 21 shows the distribution of these varieties among the various classes of plants as well as a comparison of the 1933 importations with those of 1932 for each class. The distribution of special-permit material by States is shown in table 22, which is cumulative.

TABLE 21.—*Special-permit material: Number of different varieties of plants requested and approved for the fiscal years 1920–33,*[1] *and comparison of importations for the fiscal years 1932 and 1933*

Class of plants	Number of varieties of plants for which permits were requested and approved, 1920–33			Number of plants, bulbs, etc., imported	
	Permits requested	Permits approved	Percentage approved	1932	1933
Dahlia	4,071	3,889	95.53	1,813	1,859
Gladiolus	2,474	2,298	92.89	76,455	85,812
Iris, bulbous	562	561	99.82	1,641,500	1,794,589
Iris, rhizomatous	3,163	2,982	94.28	13,213	1,206
Narcissus	2,524	2,514	99.60	1,639,186	1,076,356
Orchid	11,895	11,875	99.83	12,967	11,526
Peony	2,547	2,279	89.48	3,720	1,342
Rose	5,505	5,024	91.26	8,975	4,675
Fruit (trees and small fruits)	359	343	95.54	1,042	696
Herbaceous	7,924	7,727	97.51	37,165	34,446
Miscellaneous bulbs, roots, etc	3,680	3,639	98.89	71,597	67,643
Ornamental	17,866	17,083	95.62	39,919	48,144
Total	62,570	60,214	96.23	3,547,552	3,128,294

[1] Exclusive of varieties considered in Hawaii.

TABLE 22.—*Distribution, by States, showing number of plants, bulbs, etc., of special-permit material imported for the fiscal years 1920–33*

State or Territory	Dahlia	Gladiolus	Iris, bulbous	Iris, rhizomatous	Narcissus	Orchid	Peony
Alabama		15,115	30,980		6,000		50
Arizona	14	12			1,000	14	
Arkansas			20,000				
California	6,722	1,935,515	11,125,123	34,578	5,680,294	40,625	4,185
Colorado	66	44,197	33,490			2,055	150
Connecticut	1,301	16,744	84,822	1,584	57,293	1,527	113
Delaware		2,000	169,300	22	28	1,909	1,018
District of Columbia	166	516	215	93	267	385	
Florida		48,930	357,362		6,915,130	2,983	
Georgia	360	9,210	330,479	181	14,760		
Hawaii [1]	12	298		534		10,696	
Idaho		1,248	2,534	24			
Illinois	937	3,286,307	901,938	15,714	306,410	2,448	47,933
Indiana	207	2,390,112	502,765	3,123	1,371	360	10,213
Iowa		112,225	10,035	10	250		24,012
Kansas	99		32	2,263	141		3,070
Kentucky	408		51,200		564	415	133
Louisiana	129	2,695	32,744		10,363	2,070	
Maine		350		43		12	262
Maryland	546	41,842	844,490	413	1,923,488	648	20,833
Massachusetts	2,335	3,456,150	542,250	3,523	102,539	28,583	6,761
Michigan	4,514	12,384,515	1,188,486	3,919	2,642,338	705	87,719
Minnesota	214	89,202	345	3,485	11,000	822	7,549
Mississippi	49	6,500	52,776	9	9,260		
Missouri	253	3,173	281,211	641	1,238	4,706	991
Montana		32					
Nebraska	276	1,142					14
New Hampshire	7	40,065	21,862	71	147	185	
New Jersey	7,965	123,839	1,108,169	11,481	1,254,814	28,451	41,009
New Mexico			5,123	6	270		
New York	4,883	2,656,649	6,241,879	45,039	15,870,921	36,983	223,095
North Carolina	82	775,417	6,195,895	15	1,609,305	845	
North Dakota		63,615					7
Ohio	2,823	492,382	67,079	20,761	1,301	652	129,391
Oklahoma		510	14,000				
Oregon	1,864	76,157	1,331,936	1,746	2,757,385		2,831
Pennsylvania	2,053	394,156	462,768	2,997	3,569,418	18,823	53,970
Puerto Rico						184	
Rhode Island	1,078	2,498	258,101	1,599	316,800	157	5,209
South Carolina			297,500	2	8,890,684		
South Dakota		1,701		11			2,443
Tennessee	623		194,002	803	839,257		232
Texas	1	2,000	960,170	50	7,766,143	30	
Utah	7	1,131	30,750		11,400		
Vermont		27,062	8,010	36			2,359
Virginia	313	20,465	2,919,363	4	5,611,838	45	1,682
Washington	1,710	148,795	2,400,316	3,538	12,767,386	1,036	3,656
West Virginia		230	4,000				
Wisconsin	266	55,925	109,964	543	269,250	1,014	3,952
Total [1]	42,283	28,730,627	39,193,464	158,861	79,220,053	189,368	684,842

[1] Complete totals for Hawaii included for the first time. Previous reports carried Hawaiian totals for 1931 and 1932 only.

TABLE 22.—*Distribution, by States, showing number of plants, bulbs, etc., of special-permit material imported for the fiscal years 1920–33*—Continued

State or Territory	Rose	Fruit [1]	Herbaceous [1]	Miscellaneous bulbs, roots, etc.[1]	Ornamental	Total
Alabama	174		115	335	1,879	54,648
Arizona	9		237	4	5,227	6,517
Arkansas	50					20,050
California	42,922	454	4,979	134,129	2,101,451	21,110,977
Colorado			100		5,887	85,945
Connecticut	31,608		2,572	565	157,885	356,014
Delaware			42	175	5,319	179,813
District of Columbia	320		2	803	379	3,146
Florida	21		221	85,855	279,026	7,689,528
Georgia	108	2		180	3,279	358,559
Hawaii [2]		1,181	13	1,893	4,654	19,281
Idaho			6	193	31	4,036
Illinois	10,191	7	3,116	6,134	229,199	4,810,334
Indiana	2,780		604	7,983	30,846	2,950,364
Iowa		875	126	180	14,373	162,086
Kansas	60		50	133	574	6,422
Kentucky	2		92		64	52,878
Louisiana	190		106	773	1,615	50,685
Maine			172	980	1,013	2,832
Maryland	4,855	6	1,058	2,083	79,244	2,919,506
Massachusetts	3,442	24	1,573	4,609	438,239	4,590,028
Michigan	335		16,791	17,182	574,178	16,920,682
Minnesota	160			3,621	35,628	152,026
Mississippi	70			5	252	68,921
Missouri			274	167	19,803	312,457
Montana					100	132
Nebraska					351	1,783
New Hampshire		6	147	602	1,514	64,606
New Jersey	41,600	451	69,154	21,969	2,707,179	5,416,081
New Mexico				12		5,411
New York	28,294	309	52,781	302,257	3,080,160	28,543,250
North Carolina				20,505	764	8,602,828
North Dakota	1					63,623
Ohio	5,267	164	8,088	14,403	773,019	1,515,330
Oklahoma					198	14,708
Oregon	2,045		562	69,080	55,186	4,298,792
Pennsylvania	12,238		610	12,071	256,095	4,785,199
Puerto Rico			400		302	886
Rhode Island	552		173	2,239	46,491	634,897
South Carolina			69	33	3	9,188,291
South Dakota	3,213		12		896	8,276
Tennessee	87			637	3,462	1,039,103
Texas	808	36	10		76,357	8,805,605
Utah					4,747	48,035
Vermont				98	2,610	40,175
Virginia	16		104	4,623	45,939	8,604,392
Washington	790	3	1,226	33,259	162,371	15,524,086
West Virginia					36	4,266
Wisconsin	520		1,126	2,636	49,979	495,175
Total [2]	192,728	3,518	166,711	752,406	11,257,804	160,592,665

[1] Prior to 1929 this material was recorded under ornamentals, etc.
[2] Complete totals for Hawaii included for the first time. Previous reports carried Hawaiian totals for 1931 and 1932 only.

IMPORTATIONS OF COTTON, COTTON WRAPPINGS (BAGGING), COTTONSEED AND COTTONSEED PRODUCTS

Tables 23 to 26, inclusive, indicate, respectively, the importations during the fiscal year of cotton, cotton waste, cotton wrappings (bagging), cottonseed and cottonseed products which were inspected and when necessary fumigated or otherwise treated under supervision. The actual number of bales of cotton, cotton waste, and bagging is indicated, and inasmuch as bales vary in size they are referred to as running bales.

TABLE 23.—*Importation of running bales of ginned cotton, by country of growth and port of entry, fiscal year 1933*

Country	Boston	Buffalo	Calexico	Detroit	El Paso	Newport	New York	Niagara Falls	Philadelphia	Portland	Rouses Point	St. Albans	San Francisco	San Pedro	Seattle	Vanceboro	Total
Anglo-Egyptian Sudan	14,698						250										14,948
British West Indies	13						84										97
China	2,527						5,441						28,381	4,550	5,996		46,895
Dutch East Indies													472	313			785
Egypt	25,505						12,040										37,545
Hawaii													6				6
India	600						2,775			50			348	660	60		4,493
Japan													5				5
Mexico			4,356		212									65			4,633
Peru	455						553										1,008
United States (returned)	160	1		251		3		143	37		84	165				102	946
Total	43,958	1	4,356	251	212	3	21,143	143	37	50	84	165	29,212	5,588	6,056	102	[1] 111,361

[1] Includes 4,619 bales of linters.

TABLE 24.—*Importation of running bales of cotton waste, by country of origin and port of entry, fiscal year 1933*

Country	Baltimore	Boston	Detroit	Galveston	New Orleans	Newport	New York	Niagara Falls	Philadelphia	Portland	Richford	St. Albans	San Francisco	San Pedro	Savannah	Seattle	Total
Belgium							47										47
Canada		95	69			527		40			7	686					1,424
China							100		250								350
Cuba							21										21
England	69	1,081			3				8						6		1,167
France	12	11					953										976
Germany		192		100			63		43								398
India		425					727		75				300	75			1,602
Ireland	43						183										226
Japan	50						365		490	10			805	250		670	2,640
Morocco							50										50
Netherlands							1,044										1,044
United States (returned)			62												6		68
Total	174	1,804	131	100	3	527	3,553	40	866	10	7	686	1,105	325	12	670	10,013

TABLE 25.—*Importation of running bales of bagging, by country of origin and port of entry, fiscal year 1933*

Country	Baltimore	Beaumont	Boston	Buffalo	Charleston	Detroit	Fort Covington	Galveston	Houston	Malone	New Orleans	Newport	New York
Algeria													65
Argentina													721
Australia													5
Belgium	2,108		1,389		31			1,184	1,718		787		1,765
Canada			3,881	1,985		3,959	5			1,654		276	82
China	956												
Cuba	37							130	500		86		858
England	390	4,960	1,437		285			19,692	9,051		6,814		846
France	83		945					2,564	9,693		625		1,251
Germany		155	177		751			5,742	2,856		836		123
India								148	2,197		1,258		
Italy								379	8,543		2,334		106
Japan					200			1,519					
Netherlands	443							1,346	1,380		3,837		539
Portugal								340					
Puerto Rico													2,031
Russia													130
Scotland	282							24,473	6,800		4,974		1,122
Spain								51	1,520		243		467
Total	4,299	5,115	7,829	1,985	1,267	3,959	5	57,568	44,258	1,654	21,794	276	10,111

TABLE 25.—*Importation of running bales of bagging by country of origion and port of entry, fiscal year 1933*—Continued

Country	Niagara Falls	Norfolk	Philadelphia	Port Huron	Ranier	Rouses Point	Saint Albans	San Francisco	San Pedro	Savannah	Seattle	Vanceboro	Total
Algeria													65
Argentina			8										729
Australia													5
Austria										402			402
Belgium		2,931								1,066			12,979
Canada	1,776		2,951	1,419	25	1,980	4,198					46	24,237
China		2,260						3,588	925	3,037			10,766
Cuba													1,611
England		8,398	3,336							3,211			58,420
France		1,925								111			17,197
Germany		4,531								1,160			16,331
India													3,603
Italy													11,362
Japan		6,054						2,219		5,984	8,464		24,440
Netherlands		3,714								602			11,861
Portugal													340
Puerto Rico		100											2,131
Russia													130
Scotland		146											37,797
Spain		1,423								81			3,785
Total	1,776	31,482	6,295	1,419	25	1,980	4,198	5,807	925	15,654	8,464	46	238,191

TABLE 26.—*Importation of cottonseed, cottonseed hulls, and cottonseed products, fiscal year 1933*

Port	Cotton-seed	Cotton-seed hulls	Cotton-seed cake	Cotton-seed meal	Cotton-seed oil
	*Pounds	*Pounds*	*Pounds*	*Pounds*	*Gallons*
Boston			4,000	36,000	
Calexico	[1] 14,568	[1] 5,231,449			
El Paso				12	1¼
Laredo				8	¼
Total	14,568	5,231,449	4,000	36,020	1½

[1] Entry of cottonseed, seed cotton, and cottonseed hulls grown in the Imperial Valley, Lower California Mexico, is allowed under permit. No seed cotton was imported this year.

In addition, the Bureau supervised the entry of 6,825 samples of cotton, cotton linters, and cotton waste imported by freight, express, and parcel post, and as passenger baggage.

IMPORTATIONS OF GRAIN AND BROOMS

Table 27 indicates importations of shelled corn inspected under the provisions of Quarantine No. 41.

TABLE 27.—*Importation (pounds) of clean shelled corn under Quarantine No. 41, by port of entry and country of growth, fiscal year 1933*

Country	Balti-more	Boston	Detroit	Douglas	El Paso	New York	Niagara Falls	Nogales
Argentina	747,815	55,800				3,984,962		
Canada			383				80	
Mexico				86	40			359
Union of South Africa						96		
United States (returned)			510					
Total	747,815	55,800	893	86	40	3,985,058	80	359

Country	Phila-delphia	Puerto Rico (all ports)	Rio Grande City	San Fran-cisco	Seattle	Wash-ington	Total
Argentina	2,774,480	150,000		19,440			7,732,497
Canada						1	464
Cuba		1,704,504					1,704,504
Dominican Republic		2,957,783					2,957,783
Haiti		9,900					9,900
Mexico			8			1½	494½
Union of South Africa					6		102
United States (returned)							510
Total	2,774,480	4,822,187	8	19,440	6	2½	12,406,254½

Effective March 1, provision was made for the entry under Quarantine No. 41 of shelled corn through the mails, and of corn on the cob without permit from adjacent areas of Canada for local consumption, and under permit from certain areas in Canada and from certain other foreign countries. Since that date, 1,427 pounds of green corn on the cob were imported under inspection from Cuba and Mexico.

In addition, inspection was made under Quarantine No. 41 of 1,456 brooms made of broomcorn, and of seed other than corn as follows: Jobs-tears, 1 gram; millet, 36,109¾ pounds; and sorghum, 1¾ pounds.

In addition, the Bureau supervised the entry under Quarantine No. 55 of 70,655 pounds of seed or paddy rice.

IMPORTATIONS OF FRUITS AND VEGETABLES

Tables 28 and 29 indicate, by countries of origin and ports of entry, respectively, the fruits and vegetables imported into the continental United States and into Hawaii and Puerto Rico during the fiscal year under permit and subject to inspection at the port of first arrival under the provisions of Quarantine No. 56, and under the regulations governing the importation of potatoes into the United States.

TABLE 28.—*Fruits and vegetables imported fiscal year 1933, by countries of origin*

[Imported under Quarantine No. 56 unless otherwise designated]

Kind	Country and quantity	Total
Apple—pounds	England, 35; Ireland, 30; Netherlands, 150	215
Apricot—do	Chile, 7,748	7,748
Aralia cordata—do	Japan, 1,095	1,095
Arrowhead—do	China, 162,999; Japan, 250	163,249
Arrowroot—do	China, 200; Dominican Republic, 285	485
Artichoke (Globe)—do	Chile, 2,285	2,285
Asparagus—do	Argentina, 86,388; Chile, 4,400; Mexico, 4,663	95,451
Avocado—do	Cuba, 8,015,505; Mexico (seeds removed), 20,392	8,035,897
Balsam apple—do	Cuba, 10,610; Mexico, 583	11,193
Banana—bunches	Bermuda, 1; British Honduras, 94,082; Colombia, 2,763,882; Costa Rica, 3,719,472; Cuba, 2,673,004; Dominican Republic, 6,922; Ecuador, 27,885; Grenada, 2,107; Guatemala, 3,065,065; Haiti, 42,887; Honduras, 15,246,440; Jamaica, 2,271,074; Mexico, 5,100,906; Nicaragua, 3,289,352; Panama (including Canal Zone), 4,032,273; St. Lucia, 197; Trinidad, 763.	42,336,312
Bean (green):		
Faba—pounds	Mexico, 175	175
Lima—do	Cuba, 4,077,393; Mexico, 107,231; Virgin Islands, 785	4,185,409
String—do	Cuba, 7,655; Mexico, 2,169,871	2,177,526
Beet—do	Bermuda, 100; Mexico, 207,685	207,785
Berry (Rubus)—do	Norway, 1,635	1,635
Brussels sprouts—do	Belgium, 110; Mexico, 3	113
Cabbage—do	Cuba, 39,070; Mexico, 19,210; Newfoundland, 150	58,430
Cacao bean pod—do	Costa Rica, 180; Trinidad, 1,840	2,020
Carrot—do	Bermuda, 100; Mexico, 327,754; Virgin Islands, 160	328,014
Cassava—do	Cayman Islands, 250; China, 1,560; Cuba, 157,448; Dominican Republic, 200.	159,458
Cauliflower—do	Mexico, 576	576
Celery—do	Bermuda, 23,800; Mexico, 47	23,847
Chayote—do	Cuba, 18,761; Dominican Republic, 3,508; Mexico, 1,638	23,907
Cherimoya:		
Natural—do	Chile, 180	180
Frozen—do	Chile, 48	48
Cherry:		
Dried, sour—do	Italy, 399,220; Yugoslavia, 837,460	1,236,680
Fresh—do	Chile, 22,043	22,043
Cipollino—do	Morocco, 2,559,453; Spain, 44,092	2,603,545
Citrus medica—do	Albania, 2,700; Cuba, 95; Italy, 3,956; Palestine, 14,144	20,895
Clover top—do	Mexico, 517	517
Coriander—do	Mexico, 208	208
Cowpea—do	Mexico, 12	12
Crosnes—do	Belgium, 818	818
Cucumber—do	Chile, 1,320; Cuba, 2,675,596; Germany, 20; Mexico, 4,204	2,681,140
Dasheen (includes colocasia, inhame, malanga, taro, and yautia) (pounds).	Azores, 238,968; China, 355,624; Cuba, 241,788; Dominican Republic, 1,084,732; Japan, 168,845; Mexico, 1,827; Nicaragua, 5.	2,091,789
Eggplant—pounds	Cuba, 1,884,723; Mexico, 223,032; Virgin Islands, 1,070	2,108,825
Endive—do	Belgium, 1,245,641	1,245,641
Fennel—do	Portugal, 25	25
Garbanzo—do	Mexico, 5,058	5,058
Garlic—do	Argentina, 3,858; Chile, 1,619,427; China, 1,836; Italy, 759,801; Mexico, 1,496,605; Morocco, 13,513; Spain, 2,334,803.	6,229,843
Ginger (crude)—do	China, 389,719; Cuba, 64,202; Jamaica, 16,076; Japan, 3,700; Mexico, 2; Nicaragua, 10.	473,709
Grape:		
Fresh (not hothouse) (pounds).	Argentina, 7,578,154; Chile, 1,669,339; Mexico, 562	8,648,055
Frozen—pounds	Italy, 928	928
Hothouse—do	Belgium, 144,980	144,980
Processed—do	Italy, 35,200	35,200
Grapefruit—do	Cuba, 7,879,182; Haiti, 160	7,879,342
Horseradish—do	Germany, 114,769; Sweden, 28,331	143,100
Husk tomato—do	Mexico, 6,870	6,870
Japanese horseradish—do	Japan, 588	588
Kale—do	Bermuda, 206,605; Mexico, 4	206,609
Kohlrabi—do	Mexico, 61	61
Kudzu—do	China, 69,083; Cuba, 354	69,437
Leek—do	Mexico, 8	8
Lemon—do	Azores, 5; Chile, 24,216; Cuba, 649; Dominica, 160; Dominican Republic, 376; Italy, 10,500,286; Mexico, 76; Palestine, 3,877; Portugal, 4,752.	10,534,397
Lettuce—do	Mexico, 29,512	29,512

TABLE 28.—*Fruits and vegetables imported fiscal year 1933, by countries of origin*—Continued

Kind	Country and quantity	Total
Lily bulb (edible)--pounds--	China, 35,995; Japan, 315	36,310
Lime (sour)----------do----	Antigua, 3,400; Chile, 1,069; Costa Rica, 291; Cuba, 13,910; Dominica, 910,469; Dominican Republic, 4,566; Grenada, 9,235; Haiti, 679; Honduras, 8,228; Jamaica, 708,798; Mexico, 2,933,313; Montserrat, 45,050; Nicaragua, 1,890; St. Lucia, 444,340; St. Vincent, 2,700; Trinidad, 128,223; Virgin Islands, 5,470.	5,221,631
Mango (seeds removed, frozen) (pounds).	Philippine Islands, 365	365
Mangosteen----------do----	Honduras, 25	25
Melon----------do----	Argentina, 83,358; Chile, 5,514,896; France, 25; Mexico, 1,767,684; Portugal, 10,420; Spain, 800,064.	8,176,447
Mint----------do----	Mexico, 88	88
Mushroom----------do----	Japan, 1,190	1,190
Mustard----------do----	Cuba, 9,732; Mexico, 66,332	76,064
Nectarine----------do----	Belgium, 23; Chile, 315,517	315,540
Nuts:		
Acorn----------do----	Greece, 900,000; Turkey, 17,904,359	18,804,359
Chestnut----------do----	China, 24,100; Italy, 12,124,868; Japan, 530,387; Portugal, 1,230,791; Spain, 1,638,688.	15,548,834
Okra----------do----	Cuba, 1,420,362; Mexico, 789	1,421,151
Onion----------do----	Australia, 55,608; Bermuda, 780; Canary Islands, 41; Chile, 343,680; China, 1,270; Dominican Republic, 552; Egypt, 542,150; England, 17,920; Italy, 2,205,046; Mexico, 67,158; Netherlands, 17,920; Spain, 725,015; Virgin Islands, 8,750.	3,985,890
Orange:		
Under Quarantine No. 56 (pounds).	Cuba, 63,030	63,030
Mandarin (Quarantine No. 28) (pounds).	Japan, 1,528,371	1,528,371
Parsley----------pounds--	Mexico, 17,918	17,918
Parsnip----------do----	Mexico, 2	2
Pea----------do----	Cuba, 3,339; Mexico, 9,566,831	9,570,170
Peach----------do----	Belgium, 123; Chile, 73,458	73,581
Pear----------do----	Chile, 589	589
Pepper----------do----	Cuba, 177,223; Mexico, 1,657,174; Virgin Islands, 4,917	1,839,314
Pigeon pea----------do----	Cuba, 762; Dominican Republic, 263	1,025
Pigweed----------do----	Mexico, 881	881
Pineapple----------crates--	Azores, 33; Cuba, 748,008; Ecuador, 44; Haiti, 26; Honduras, 44; Mexico, 27,599; Philippine Islands, 3,954.	779,708
Plantain----------pounds--	British Honduras, 43,120; Cuba, 5,034,797; Dominican Republic, 9,089,248; Haiti, 8,091; Honduras, 806,726; Nicaragua, 3,180; Panama (including Canal Zone), 229,457; St. Lucia, 700.	15,215,319
Plum----------do----	Chile, 164,866	164,866
Potato:		
Under Quarantine No. 56 (pounds).	Bermuda, 1,826,527	1,826,527
Under potato regulations (order of Dec. 22, 1913) (pounds).	Canary Islands, 59,564; Cuba, 2,199,826; Mexico, 52,100; Spain, 259,957.	2,571,447
Pricklypear--------pounds--	Mexico, 2,182	2,182
Pumpkin----------do----	Cuba, 142,390; Dominican Republic, 39,613; Jamaica, 350; Mexico, 8,658.	191,011
Purslane----------do----	Mexico, 1,246	1,246
Radish----------do----	Mexico, 73,327	73,327
St. Johns bread--------do----	Cyprus, 400,000; Greece, 132,161; Italy, 236,659; Portugal, 680; Sicily, 44,600.	814,100
Salsify----------do----	Mexico, 1,166	1,166
Spinach----------do----	Cuba, 88; Mexico, 48,667	48,755
Squash----------do----	Cuba, 21,056; Mexico, 157,497	178,553
Strawberry:		
Natural----------do----	Mexico, 20	20
Frozen----------do----	Chile, 34	34
Sweetpotato----------do----	China, 9,600; Virgin Islands, 54	9,654
Swiss chard----------do----	Mexico, 2,902	2,902
Tamarind bean pod--do----	Antigua, 55,372; Cuba, 2,050; India, 3,008; Mexico, 317; St. Lucia, 8,400.	69,147
Tangerine----------do----	Cuba, 125	125
Tomato----------do----	Bahamas, 256,879; Canary Islands, 4,746; Chile, 96; Cuba, 23,093,488; Dominica, 294; Mexico, 34,079,525; Montserrat, 3,120; Virgin Islands, 278,235.	57,716,383
Turnip----------do----	Cuba, 336; Mexico, 214,515; Newfoundland, 150	215,001
Vaccinium (cranberry, etc.):		
Natural--------pounds--	Estonia, 3,960; Finland, 1,200; Newfoundland, 249,057	254,217
Frozen----------do----	Newfoundland, 1,516,560	1,516,560
Water caltrop--------do----	China, 13,985	13,985
Waterchestnut--------do----	China, 1 591 910	1,591,910
Watercress----------do----	Mexico, 5,238	5,238
Waterlily root--------do----	China, 22,561; Cuba, 61,783	84,344
Watermelon----------do----	Cuba, 230,485; Mexico, 1,111,816	1,342,301
Yam----------do----	China, 26,285; Japan, 16,260	42,545
Yam bean root-------do----	China, 20,510; Mexico, 969	21,479

TABLE 29.—*Fruits and vegetables imported fiscal year 1933, by ports of entry*

[Imported under Quarantine No. 56 unless otherwise designated]

Kind	Port and quantity	Total
Apple, pounds	Boston, 35; New York, 180	215
Apricot, do	New York, 7,748	7,748
Aralia cordata, do	Hawaii (all ports), 1,095	1,095
Arrowhead, do	Boston, 8,100; Buffalo, 17,100; Cleveland, 492; Detroit, 500; Hawaii (all ports), 31,287; Los Angeles, 300; New York, 21,600; Niagara Falls, 2,900; San Francisco, 75,900; Seattle, 5,070.	163,249
Arrowroot, do	New York, 285; Niagara Falls, 200	485
Artichoke (globe), do	New York, 2,285	2,285
Asparagus, do	Calexico, 4; El Paso, 2; Naco, 5; New York, 90,788; San Ysidro, 4,652.	95,451
Avocado, do	Boston, 480; Brownsville (seeds removed), 3,367; Douglas (seeds removed), 333; Eagle Pass (seeds removed), 3,272; El Paso (seeds removed), 5,667; Hidalgo (seeds removed), 1,876; Key West, 699,287; Laredo (seeds removed), 3,824; Miami, 103,245; Naco (seeds removed), 17; New Orleans, 1,999,294; New York, 2,532,469; Nogales (seeds removed), 1,963; Philadelphia, 468; Rio Grande City (seeds removed), 36; Roma (seeds removed), 37; Tampa, 2,680,262.	8,035,897
Balsam apple, do	Calexico, 583; New York, 10,610	11,193
Banana, bunches	Baltimore, 2,182,267; Boston, 4,050,280; Brownsville, 72,751; Calexico, 1; Charleston, 804,733; Detroit, 1,375; Eagle Pass, 5,999; Eastport, 4; El Paso, 62,756; Galveston, 2,199,536; Hidalgo, 820; Key West, 1,113; Laredo, 224,388; Los Angeles, 1,163,352; Miami, 185,162; Mobile, 2,276,084; New Orleans, 10,856,307; New York, 12,182,356; Nogales, 388; Norfolk, 262,290; Philadelphia, 3,978,544; Puerto Rico (all ports), 6,855; Rouses Point, 25; San Francisco, 1,370,756; San Ysidro, 3; Sault Ste. Marie, 2,680; Savannah, 13,681; Seattle, 16,603; Tampa, 410,696; Trout River, 14; Wilmington, 4,493.	42,336,312
Bean (green):		
Faba, pounds	Calexico, 8; Nogales, 167	175
Lima, do	Laredo, 32,290; New York, 4,077,633; Nogales, 74,941; Puerto Rico (all ports), 545.	4,185,409
String, do	Brownsville, 83,028; Calexico, 838; Douglas, 1,342; Eagle Pass, 2,071; El Paso, 66,334; Laredo, 833,564; Naco, 662; New York, 7,655; Nogales, 1,119,859; Roma, 15; San Ysidro, 62,158.	2,177,526
Beet, do	Calexico, 843; Douglas, 4,223; Eagle Pass, 278; El Paso, 192,985; Naco, 180; New York, 100; Nogales, 9,176.	207,785
Berry (*Rubus*), do	New York, 1,635	1,635
Brussels sprouts, do	Calexico, 3; New York, 110	113
Cabbage, do	Boston, 150; Calexico, 948; Douglas, 2,845; Eagle Pass, 123; El Paso, 324; Naco, 563; New Orleans, 225; New York, 38,845; Nogales, 14,407.	58,430
Cacao bean pod, do	New York, 2,020	2,020
Carrot, do	Calexico, 1,439; Douglas, 2,871; Eagle Pass, 251; El Paso, 303,625; Naco, 289; New York, 170; Nogales, 19,279; Puerto Rico (all ports), 90.	328,014
Cassava, do	Key West, 7,749; New York, 131,529; Philadelphia, 200; Seattle, 1,460; Tampa, 18,520.	159,458
Cauliflower, do	Calexico, 5; El Paso, 9; Naco, 6; Nogales, 556	576
Celery, do	New York, 23,800; Nogales, 47	23,847
Chayote, do	Calexico, 1; El Paso, 538; Key West, 470; Laredo, 1,070; New Orleans, 4,815; New York, 16,984; Nogales, 29.	23,907
Cherimoya:		
Natural, do	New York, 180	180
Frozen, do	New York, 48	48
Cherry:		
Dried, sour, do	New York, 1,107,852; Philadelphia, 128,828	1,236,680
Fresh, do	New York, 22,043	22,043
Cipollino, do	Boston, 44,092; New York, 2,515,416; Philadelphia, 44,037	2,603,545
Citrus medica, do	Detroit, 195; El Paso, 5; New York, 20,695	20,895
Clover top, do	Douglas, 517	517
Coriander, do	Calexico, 208	208
Cowpea, do	Calexico, 12	12
Crosnes, do	New York, 818	818
Cucumber, do	Baltimore, 20; Calexico, 374; El Paso, 287; Key West, 2,360; Laredo, 1,421; Miami, 9,646; Naco, 206; New Orleans, 99,831; New York, 2,565,079; Nogales, 1,916.	2,681,140
Dasheen (includes colocasia, inhame, malanga, taro, and yautia) (pounds).	Boston, 6,675; Buffalo, 5,700; Calexico, 1,827; Cleveland, 705; Detroit, 1,000; Hawaii (all ports), 325; Key West, 8,966; Los Angeles, 23,300; Miami, 415; New York, 996,664; Niagara Falls, 13,840; Providence, 156,190; Puerto Rico (all ports), 414,066; San Francisco, 330,946; Seattle, 115,618; Tampa, 15,552.	2,091,789
Eggplant, pounds	Boston, 36; Calexico, 142; El Paso, 8,354; Laredo, 3,843; New Orleans, 55,341; New York, 1,830,416; Nogales, 210,693.	2,108,825
Endive, do	Los Angeles, 1,989; New York, 1,241,144; San Francisco, 1,708; Seattle, 800.	1,245,641

TABLE 29.—*Fruits and vegetables imported fiscal year 1933, by ports of entry*—Con.

Kind	Port and quantity	Total
Fennel ..... pounds	New York, 25	25
Garbanzo ..... do	Brownsville, 5,058	5,058
Garlic ..... do	Boston, 188,086; Brownsville, 1,225; Calexico, 176,636; Douglas, 2,998; Eagle Pass, 12,904; El Paso, 30,390; Hawaii (all ports), 1,836; Laredo, 872,294; Los Angeles, 4,200; Mobile, 5,500; Naco, 444; New Orleans, 152,108; New York, 1,939,082; Nogales, 3,873; Puerto Rico (all ports), 2,822,637; San Francisco, 2,635; San Ysidro, 12,995.	6,229,843
Ginger (crude) ..... do	Boston, 11,170; Buffalo, 11,600; Calexico, 2; Chicago, 500; Detroit, 1,200; Hawaii (all ports), 2,000; Los Angeles, 9,500; New York, 148,294; Niagara Falls, 13,164; Portland, 400; San Francisco, 257,345; Seattle, 18,534.	473,709
Grape:		
Fresh (not hothouse) pounds.	Calexico, 71; Eagle Pass, 265; El Paso, 105; Laredo, 120; New York, 8,647,493; Nogales, 1.	8,648,055
Frozen ..... pounds	New York, 928	928
Hothouse ..... do	New York, 144,955; San Francisco, 25	144,980
Processed ..... do	New York, 35,200	35,200
Grapefruit ..... do	Key West, 1,707,008; New Orleans, 1,827,540; New York, 4,344,654; Tampa, 140.	7,879,342
Horseradish ..... do	New York, 143,100	143,100
Husk tomato ..... do	Brownsville, 120; Calexico, 2; El Paso, 6,748	6,870
Japanese horseradish ..... do	Hawaii (all ports), 588	588
Kale ..... do	Calexico, 4; New York, 206,605	206,609
Kohlrabi ..... do	Calexico, 36; El Paso, 25	61
Kudzu ..... do	Boston, 2,900; Buffalo, 2,900; Chicago, 200; Detroit, 400; Los Angeles, 600; New York, 12,852; Niagara Falls, 4,500; San Francisco, 43,549; Seattle, 1,536.	69,437
Leek ..... do	Calexico, 8	8
Lemon ..... do	Boston, 75,503; Brownsville, 76; Buffalo, 22,357; Detroit, 198; New Orleans, 1,047,293; New York, 9,328,942; Pensacola, 59,680; Providence, 8; Puerto Rico (all ports), 140; Trout River, 200.	10,534,397
Lettuce ..... do	Brownsville, 84; Calexico, 557; Douglas, 2,171; Eagle Pass, 777; El Paso, 62; Naco, 718; Nogales, 25,143.	29,512
Lily bulb (edible) ..... do	Boston, 3,470; Buffalo, 2,518; Detroit, 600; Hawaii (all ports), 1,955; Los Angeles, 300; New York, 6,884; Niagara Falls, 3,600; Portland, 10; San Francisco, 15,093; Seattle, 1,880.	36,310
Lime (sour) ..... do	Boston, 17,185; Brownsville, 34,603; Eagle Pass, 253,737; El Paso, 77,176; Key West, 1; Laredo, 2,285,570; Los Angeles, 213,782; Miami, 2,719; Mobile, 34,421; New Orleans, 58,778; New York, 2,173,008; Nogales, 43,926; Norfolk, 13,009; Philadelphia, 5,640; Puerto Rico (all ports), 360; San Francisco, 5,664; San Ysidro, 482; Seattle, 900; Tacoma, 670.	5,221,631
Mango (seeds removed, frozen) (pounds).	New York, 91; Portland, 100; San Francisco, 174	365
Mangosteen ..... pounds	Boston, 25	25
Melon ..... do	Baltimore, 25; Boston, 6,650; Brownsville, 834; Calexico, 446,503; El Paso, 19,027; Hidalgo, 3,575; Laredo, 1,272,259; Mercedes, 557; Naco, 35; New York, 6,402,088; Nogales, 24,894.	8,176,447
Mint ..... do	Calexico, 2; Douglas, 5; El Paso, 80; Nogales, 1	88
Mushroom ..... do	Hawaii (all ports), 1,190	1,190
Mustard ..... do	Calexico, 26,589; Douglas, 1,632; El Paso, 29,576; New York, 9,732; Nogales, 8,535.	76,064
Nectarine ..... do	New York, 315,540	315,540
Nuts:		
Acorn ..... do	New York, 18,676,492; Philadelphia, 127,867	18,804,359
Chestnut ..... do	Hawaii (all ports), 191,470; Los Angeles, 165,580; New York, 15,002,787; San Francisco, 157,397; Seattle, 31,600.	15,548,834
Okra ..... do	Brownsville,[1] 160; Calexico, 20; El Paso, 528; Key West, 17,442; New Orleans, 596,425; New York, 546,039; Nogales, 81; Tampa, 260,456.	1,421,151
Onion ..... do	Boston, 1,011,545; Brownsville, 278; Calexico, 5,456; Douglas, 8,022; Eagle Pass, 2,363; El Paso, 22,284; Naco, 2,344; New York, 2,849,757; Nogales, 26,411; Puerto Rico (all ports), 552; San Francisco, 39,378; Seattle, 17,500.	3,985,890
Orange:		
Under Quarantine No. 56 (pounds).	Miami, 42; New Orleans, 50,509; New York, 12,479	63,030
Mandarin (Quarantine No. 28) (pounds).	Seattle, 1,528,371	1,528,371
Parsley ..... pounds	Calexico, 82; Douglas, 70; El Paso, 17,108; Naco, 7; Nogales, 651	17,918
Parsnip ..... do	Calexico, 2	2
Pea ..... do	Calexico, 248; Douglas, 641; Eagle Pass, 39; El Paso, 110; Laredo, 2,255; Naco, 5; New York, 3,339; Nogales, 9,399,412; San Ysidro, 164,121.	9,570,170
Peach ..... do	New York, 73,581	73,581
Pear ..... do	New York, 589	589

[1] Okra was admitted from Tamaulipas, Mexico, through the port of Brownsville under special conditions.

TABLE 29.—*Fruits and vegetables imported fiscal year 1933, by ports of entry*—Con.

Kind	Port and quantity	Total
Pepper----------pounds--	Boston, 252; Brownsville, 3,982; Calexico, 1,627; Del Rio, 6,982; Douglas, 7,851; Eagle Pass, 61,314; El Paso, 225,519; Hidalgo, 3,610; Laredo, 115,726; Naco, 1,207; New Orleans, 11,835; New York, 169,918; Nogales, 1,224,593; Puerto Rico (all ports), 135; San Ysidro, 4,653; Ysleta, 110.	1,839,314
Pigeon pea----------do----	New York, 1,025	1,025
Pigweed----------do----	Douglas, 635; Naco, 125; Nogales, 121	881
Pineapple----------crates--	Brownsville, 1,941; Douglas, 2; Eagle Pass, 1; El Paso, 4,196; Key West, 338,095; Laredo, 20,917; Miami, 2,273; New Orleans, 89,745; New York, 305,502; Nogales, 41; Portland, 3,049; Providence, 28; San Francisco, 944; Seattle, 5; Tampa, 12,969.	779,708
Plantain----------pounds--	Boston, 14,250; Key West, 402,830; Miami, 129,486; Mobile, 1,340; New Orleans, 410,757; New York, 4,157,716; Norfolk, 27,192; Philadelphia, 119,570; Puerto Rico (all ports), 9,093,580; Tampa, 858,598.	15,215,319
Plum----------do----	New York, 164,866	164,866
Potato:		
Under Quarantine No. 56 (pounds).	New York, 1,826,527	1,826,527
Under potato regulations (order of Dec. 22, 1913) (pounds).	Douglas, 24,895; Key West, 54; Naco, 4,630; New Orleans, 61,822; New York, 2,151,530; Nogales, 22,575; Puerto Rico (all ports), 305,941.	2,571,447
Prickly pear----------pounds--	Calexico, 8; El Paso, 290; Laredo, 1,880; Nogales, 4	2,182
Pumpkin----------do----	Brownsville, 975; Calexico, 1,527; Douglas, 3,358; Eagle Pass, 546; Key West, 6,043; Laredo, 1,399; Naco, 746; New Orleans, 350; New York, 175,960; Nogales, 91; Rio Grande City, 16.	191,011
Purslane----------do----	Calexico, 214; Douglas, 270; Nogales, 762	1,246
Radish----------do----	Calexico, 2,681; Douglas, 239; Eagle Pass, 29; El Paso, 63,423; Naco, 43; Nogales, 6,912.	73,327
St. Johns bread----------do----	New York, 814,100	814,100
Salsify----------do----	Calexico, 26; San Ysidro, 1,140	1,166
Spinach----------do----	Calexico, 1,179; Douglas, 1,377; El Paso, 28,590; Naco, 626; New York, 88; Nogales, 16,895.	48,755
Squash----------do----	Calexico, 2,916; Douglas, 7,617; Eagle Pass, 1,049; El Paso, 39,174; Laredo, 84,213; Naco, 712; New York, 21,056; Nogales, 21,686; Rio Grande City, 12; San Ysidro, 118.	178,553
Strawberry:		
Natural----------do----	Nogales, 20	20
Frozen----------do----	New York, 34	34
Sweetpotato----------do----	Hawaii (all ports), 9,600; Puerto Rico (all ports), 54	9,654
Swiss chard----------do----	El Paso, 2,872; Nogales, 30	2,902
Tamarind bean pod--do----	Calexico, 3; El Paso, 110; Laredo, 200; New Orleans, 1,530; New York, 67,302; Nogales, 2.	69,147
Tangerine----------do----	New York, 125	125
Tomato----------do----	Boston, 177,477; Brownsville, 4,310; Buffalo, 116,586; Calexico, 8,898; Del Rio, 4,508; Douglas, 15,192; Eagle Pass, 40,779; El Paso, 144,652; Hidalgo, 1,847; Key West, 375,496; Laredo, 955,136; Los Angeles, 7,839,176; Miami, 19,500; Naco, 2,588; New Orleans, 687,184; New York, 22,270,695; Niagara Falls, 20,660; Nogales, 23,605,508; Puerto Rico (all ports), 92,650; Rio Grande City, 3; Roma, 5; San Diego, 17,280; San Francisco, 1,236,723; San Ysidro, 1,530; Seattle, 78,000.	57,716,383
Turnip----------do----	Boston, 150; Calexico, 78; Douglas, 780; Eagle Pass, 5; El Paso, 206,289; Naco, 29; New York, 336; Nogales, 7,334.	215,001
Vaccinium (cranberry, etc.):		
Natural----------pounds--	Boston, 25,830; New York, 228,387	254,217
Frozen----------do----	Boston, 434,830; New York, 1,081,730	1,516,560
Water caltrop----------do----	Boston, 500; Hawaii (all ports), 5,480; New York, 1,305; San Francisco, 6,700.	13,985
Waterchestnut----------do----	Boston, 69,214; Buffalo, 88,433; Chicago, 64,000; Cleveland, 7,071; Detroit, 31,500; Hawaii (all ports), 120,262; Los Angeles, 46,240; New York, 312,776; Niagara Falls, 55,743; Portland, 8,600; San Francisco, 505,653; Seattle, 282,418.	1,591,910
Watercress----------do----	Calexico, 78; Douglas, 752; Naco, 138; Nogales, 4,270	5,238
Waterlily root----------do----	Boston, 2,372; New York, 61,783; Niagara Falls, 500; Portland, 360; San Francisco, 7,800; Seattle, 11,529.	84,344
Watermelon----------do----	Brownsville, 137,080; Calexico, 495,319; Douglas, 670; El Paso, 805; Hidalgo, 173,640; Mercedes, 20,700; Naco, 352; New Orleans, 45,315; New York, 185,170; Nogales, 281,113; Rio Grande City, 1,437; Roma, 700.	1,342,301
Yam----------do----	Hawaii (all ports), 42,545	42,545
Yam bean root----------do----	Hawaii (all ports), 3,220; El Paso, 969; Los Angeles, 1,300; New York, 3,100; San Francisco, 12,890.	21,479

PLANTS AND PLANT PRODUCTS ENTERED FOR EXPORTATION OR FOR TRANSPORTATION AND EXPORTATION

In addition to the regulated imports for consumption entry recorded in tables 15 to 29, this Bureau supervised the entry under permit, either for exportation or for transportation and exportation, of considerable quantities of plants and plant products, as follows: Flower bulbs, corms, and tubers, 1,285,690; fruit trees, 54,128; cacti and succulents, 21,711; orchids, 495; miscellaneous plants, 5,521; acorns, 379,575 pounds; apples, 163,891 pounds; bananas, 6 bunches; beans (string), 195,300 pounds; cherries, 700 pounds; chestnuts, 43 pounds; cipollini, 190 pounds; *Citrus medica*, 180 pounds; eggplants, 35,758 pounds; garlic, 2,452,816 pounds; ginger, 683 pounds; grapes, 61,853 pounds; grapefruit, 10,549,001 pounds; husk tomatoes, 1,608 pounds; kudzu, 754 pounds; lemons, 7,849,514 crates; lily bulbs (edible), 955 pounds; limes (sour), 7,970 pounds; mangoes, 50 pounds; melons, 535,502 pounds; nectarines, 1,400 pounds; onions, 5,916,823 pounds; oranges, 1,167,841 pounds; peas, 1,330,176 pounds; peaches, 18,397 pounds; peppers, 84,409 pounds; pineapples, 103,997 crates; plums, 1,336 pounds; potatoes, 664,501 pounds; pumpkins, 963 pounds; St. Johns bread, 110 pounds; tamarind bean pods, 44 pounds; tangerines, 1,600 pounds; tomatoes, 13,203,197 pounds; waterchestnuts, 2,300 pounds; waterlily roots, 679 pounds; watermelons, 215,770 pounds; yam bean roots, 200 pounds; corn, 818,820 pounds; cotton, 74,603 bales and 15 packages, including 920 bales and 5 packages of linters; cottonseed cake, 1,665,950 pounds; cotton waste, 156 bales and 4 packages; seed or paddy rice, 9,471 pounds.

MARITIME-PORT INSPECTION

SHIP INSPECTION

The inspection of ships from foreign countries and from Hawaii and Puerto Rico has been continued along the lines described in previous annual reports.

The inspection at ports in California, Florida, Hawaii, and certain ports in Puerto Rico has been performed by State and Territorial officials serving as collaborators of the Bureau of Plant Quarantine at a very small cost to the Department.

A record by ports of the ship inspection appears in table 30.

TABLE 30.—*Ships inspected, fiscal year 1933*

Port	From foreign ports												From Hawaii						From Puerto Rico						From United States ports via Panama Canal		
	Direct			Via United States ports			Via Hawaii			Via Puerto Rico			Direct			Via United States ports			Direct			Via United States ports					
	Arrived	Inspected	With contraband	Arrived	Inspected	With contraband	Arrived	Inspected	With contraband	Arrived	Inspected	With contraband	Arrived	Inspected	With contraband	Arrived	Inspected	With contraband	Arrived	Inspected	With contraband	Arrived	Inspected	With contraband	Arrived	Inspected	With contraband
Baltimore	374	368	289	543	535	335	1	1	0	0	0	0	3	3	1	26	24	2	7	7	4	32	32	20	172	169	25
Bellingham	259	109	26	0	0	0	0	0	0	0	0	0	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Boston	1,212	1,208	637	274	272	117	0	0	0	0	0	0	0	0	0	20	20	0	15	15	3	1	1	1	205	205	2
Brunswick [1]	6	6	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Charleston	111	111	90	99	98	57	0	0	0	0	0	0	0	0	0	0	0	0	21	21	6	5	5	1	23	23	3
Chicago	10	10	7	4	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corpus Christi	40	40	38	106	106	56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	0	22	22	1
Galveston	285	284	264	551	545	304	0	0	0	0	0	0	0	0	0	0	0	0	4	4	2	4	4	0	5	5	0
Gulfport [2]	6	6	6	96	93	32	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	5	5	1	1	1	1
Honolulu [3]	179	179	92	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	91	91	1
Houston	176	176	24	704	704	1	0	0	0	2	2	1	14	14	0	1	1	0	10	10	0	30	30	0	97	97	0
Jacksonville [3]	94	94	23	114	114	1	1	0	0	1	0	0	0	0	0	1	1	1	9	9	1	6	6	1	32	32	0
Key West [3]	451	451	175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Miami [3]	582	582	176	4	4	0	0	0	0	1	1	1	0	0	0	0	0	0	6	6	1	0	0	0	0	0	0
Mobile	179	179	151	340	340	201	0	0	0	0	0	0	0	0	0	4	4	0	16	16	11	13	13	1	60	60	2
New Orleans	963	963	599	421	407	235	1	1	1	0	0	0	16	16	9	10	10	3	25	25	3	5	5	0	59	59	1
Newport News [3]	51	16	16	340	15	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
New York	3,324	3,266	2,277	865	694	321	6	6	3	116	114	95	1	1	0	32	27	7	158	158	109	19	6	2	212	197	2
Norfolk	243	239	117	688	644	213	0	0	0	0	0	0	0	0	0	1	1	0	9	9	0	28	28	2	90	85	3
Pensacola [3]	55	55	12	162	162	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0
Philadelphia	636	635	423	835	828	560	0	0	0	0	0	0	7	7	5	15	15	1	41	41	30	1	1	1	196	189	12
Port Arthur	209	204	72	261	253	30	0	0	0	0	0	0	0	0	0	0	0	0	6	6	3	0	0	0	13	13	1
Portland, Oreg	68	68	30	382	382	117	0	0	0	0	0	0	2	2	1	2	2	0	0	0	0	0	0	0	386	386	0
Providence [4]	49	9	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Puerto Rico (all ports)	1,159	1,159	641	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	25	11
San Diego [3]	778	778	18	28	28	0	2	2	0	0	0	0	23	23	2	1	1	0	0	0	0	0	0	0	148	148	21
San Francisco [3]	481	481	99	585	585	75	105	105	73	0	0	0	160	160	23	9	9	0	0	0	0	0	0	0	520	520	6
San Pedro [3]	1,187	1,187	268	545	545	39	77	77	34	1	1	0	47	47	5	19	19	0	2	2	0	0	0	0	721	721	7
Savannah	65	65	56	128	105	78	0	0	0	0	0	0	0	0	0	1	1	0	13	13	9	1	1	0	22	10	1
Seattle	1,313	1,173	193	257	257	167	5	5	0	0	0	0	4	4	1	10	10	0	0	0	0	0	0	0	79	79	3
Tampa [3]	186	186	13	238	238	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	13	13	0	0	0	0
West Palm Beach [3]	108	108	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	14,839	14,395	6,851	8,583	7,967	2,960	198	197	111	121	118	97	279	279	48	154	147	14	343	343	182	169	156	30	3,183	3,138	103

[1] Work handled by inspector stationed at Savannah, Ga.
[2] Work handled by inspectors stationed at Mobile, Ala.
[3] Collaborators stationed at these ports.
[4] Work handled by inspectors stationed at Boston, Mass.

NOTE.—The foreign-ship arrivals do not in all cases agree with customs figures. Foreign ships may put in for bunkers and be inspected by inspectors of the Bureau of Plant Quarantine but not entered by customs. On the other hand, ships entered at certain small subports are included in customs records but not in this report.

CARGO INSPECTION

All importations of plants and plant products subject to quarantine restrictions were inspected at the port of entry or the port of first arrival and a record of such importations by port appears in table 31.

TABLE 31.—*Inspection of shipments of plants and plant products offered for entry, fiscal year 1933*

Port	Shipments inspected and entered under permit	Shipments refused entry	Port	Shipments inspected and entered under permit	Shipments refused entry	Port	Shipments inspected and entered under permit	Shipments refused entry
Baltimore	200	0	Hidalgo	214	0	Port Huron [1]	53	3
Bellingham	81	0	Honolulu [1]	491	139	Portland, Oreg.	19	0
Blaine	15	0	Houston	201	0	Presidio	9	0
Boston	1,033	1	Key West [1]	587	0	Providence [2]	19	0
Brownsville	437	0	Laredo	2,193	0	Puerto Rico (all ports)	637	0
Buffalo	299	1	Mercedes	9	0	Rio Grande City	6	0
Calexico	353	0	Miami [1]	73	1	Roma	27	0
Charleston	61	1	Mobile	112	4	San Francisco [1]	1,227	10
Chicago	19	1	Naco	5	0	San Pedro [1]	542	2
Del Rio	102	0	New Orleans	1,684	3	San Ysidro	153	0
Detroit	333	59	New York	11,128	22	Savannah	75	0
Douglas	41	0	Nogales	2,681	4	Seattle	233	1
Eagle Pass	351	1	Norfolk	216	1	Tampa [1]	864	0
El Paso	5,007	0	Pensacola [1]	2	0			
Fabens	1	0	Philadelphia	364	15			
Galveston	282	3	Port Arthur	2	0	Total	32,441	272

[1] Collaborators are stationed at these ports.
[2] Work handled by inspectors stationed at Boston, Mass.

In addition to the importations credited to the Mexican border ports there were several thousand importations which were so small that no duty was assessed by customs and no entry made.

Disinfection is required of certain commodities as a condition of entry and of other commodities when inspection reveals the presence of injurious insects or plant diseases. The following plant material was treated under supervision of inspectors of this Bureau during the fiscal year: Cotton, 108,648 bales (including 212 bales of linters) and 6,675 cotton samples; cotton waste, 2,665 bales; bagging 1,818 bales; chestnuts, 15,323 cases; tree seeds, 3,909 pounds and 16 packages; miscellaneous plant material, 984 packages; narcissus bulbs imported under special permit, 1,076,356; and bulbous iris, 1,106,428.

It has also been necessary for inspectors at several ports to devote considerable time to the inspection of miscellaneous cargoes in order to establish the true status of the material and to supervise the cleaning by importers of products contaminated with objectionable material such as soil.

The demand for inspection of docks and ships for the presence of insects injurious to flour decreased considerably over the previous fiscal year. At Galveston 8 ship inspections were made, at Houston 24 ship inspections, and at New Orleans 23 ship and 1 dock inspections.

AIRPLANE INSPECTION

Airplanes from foreign countries were inspected at the following 10 ports of entry: Brownsville, El Paso, and Laredo, Tex.; Nogales, Ariz.; Calexico and San Diego, Calif.; Miami and West Palm Beach, Fla.; San Juan, P.R.; and Seattle, Wash. A total of 3,427 airplanes was inspected during the year, and 626 interceptions of prohibited plant material were made.

FOREIGN PARCEL-POST INSPECTION

Through cooperation with the customs and post-office officials, all mail packages from foreign countries which are found to contain plants or plant products are referred to inspectors of the Bureau for examination. Such packages arriving at

ports of entry where there are no representatives of the Bureau are forwarded by the postal officials to the nearest port at which a plant quarantine inspector is stationed.

Table 32 indicates by port the number and disposition of foreign-mail packages inspected during the fiscal year.

TABLE 32.—*Number of inspections of foreign parcel-post packages, fiscal year 1933*

Port	Inspected	Refused entry (entire or in part)	Diverted to Washington	Port	Inspected	Refused entry (entire or in part)	Diverted to Washington
Baltimore	1,408	96	71	Naco	42	1	0
Boston	2,206	139	380	New Orleans	62	25	30
Brownsville	584	5	0	New York	1,905	567	437
Buffalo	44	27	1	Nogales	5	1	2
Chicago	3,952	493	56	Norfolk	1	0	1
Detroit	4,703	202	206	Philadelphia	7,822	354	166
Douglas	15	0	0	Portland	25	2	10
Eagle Pass	171	0	0	Presidio	37	0	0
El Paso	467	108	37	Puerto Rico (all ports)	19	11	0
Honolulu [1]	1,010	94	2	St. Paul [3]	2,978	282	82
Houston	2	0	0	San Diego [1]	32	0	0
Jacksonville [1]	350	19	93	San Francisco [1]	4,284	344	0
Laredo	492	33	11	Seattle	601	68	1
Los Angeles [1] [2]	4,799	185	0	Tampa [1]	1	1	0
Miami [1]	36	30	4				
Mobile	13	2	0	Total	38,066	3,089	1,590

[1] Collaborators are stationed at these ports.
[2] 372 packages were diverted to San Francisco for treatment.
[3] Records cover the period October 1932 to June 1933, inclusive.

MEXICAN BORDER SERVICE

The movement of railway cars from Mexico continued to decline over the last fiscal year. A total of 13,302 freight cars was inspected in the Mexican railway yards. Of these, 12,448 entered the United States, 3,090 being fumigated as a condition of entry. Four hundred and ninety-nine cars were found to be contaminated with cottonseed and were required to be cleaned before entry was permitted. The usual fee of $4 was collected for each car fumigated, and all fees collected were covered into the Treasury as miscellaneous receipts.

A summary of the railway-car inspection and fumigation is given in table 33.

TABLE 33.—*Inspection and fumigation of railway cars crossing the border from Mexico, fiscal year 1933*

Port	Cars inspected	Cars with cottonseed	Cars entered	Cars fumigated	Fees collected
Brownsville	240	31	183	22	$88
Douglas	377	11	377	14	56
Eagle Pass	1,104	92	1,036	331	1,400
El Paso	2,303	44	2,151	[1] 460	1,692
Laredo	4,704	207	4,375	1,528	6,144
Naco	514	7	514	6	24
Nogales	4,046	106	3,798	726	3,000
Presidio	14	1	14	3	12
Total	13,302	499	12,448	3,090	[2] 12,416

[1] Includes 3 cars not from Mexico.
[2] The apparent discrepancy in fees collected and the number of cars fumigated may be explained by the fact that it is customary for the railroads to puchase fumigation coupons in advance.

In addition to the freight cars listed in table 33, 2,525 Pullman and passenger coaches crossed the border and were inspected.

Plant-quarantine inspectors on the Mexican border take an active part in cooperation with the Customs Service, in the inspection of vehicles, baggage, personal effects, and express packages from Mexico. Approximately 3,500,000 vehicles crossed the border from Mexico during the fiscal year, and a total of 100,833 pieces of baggage was examined. The inspection of these vehicles and baggage resulted in the interception of a large quantity of prohibited plant material. A record of such interceptions appears in table 38.

While there was a decided increase in the small lots of fruits and vegetables brought over for local consumption, the carload shipments of fruits and vegetables were considerably below normal. One thousand six hundred and one cars of tomatoes, 673 cars of green peas, 588 cars of bananas, and 287 cars miscellaneous fruits and vegetables entered at the various ports.

INSPECTION IN PUERTO RICO AND HAWAII

In addition to the enforcement of the foreign-plant quarantines and regulatory orders, inspectors stationed in Puerto Rico also enforce the provisions of Quarantine No. 58. This involves the inspection of fruits and vegetables in the fields, in packing houses, and on the docks, and all shipments of such products moving to the mainland have been certified as free from pests.

Parcel-post packages originating on the island and destined for points on the mainland are also inspected. A total of 892 such packages was inspected during the year, and 95 were found to contain prohibited plant material and were returned to the sender.

Insular quarantine inspectors rendered valuable assistance in the enforcement of the foreign-plant quarantines and regulatory orders.

A record by months of the number of containers of fruits and vegetables inspected and certified for shipment to the mainland appears in table 34.

Inspectors stationed in Hawaii are engaged principally with the enforcement of Quarantine No. 13, on account of the Mediterranean fruit fly and the melon fly. Inspections were made in the fields, packing sheds, and on the docks of such fruits and vegetables as are permitted to move to the mainland.

The inspection of parcel-post packages originating in the Hawaiian Islands and destined for points on the mainland was continued throughout the year. A total of 75,962 packages were opened and examined; 89,770 packages were inspected without opening, and 103 packages were found to contain prohibited plant material.

As an accommodation to travelers between Hawaii and the mainland, it has been the practice for some years to inspect and seal baggage in Honolulu, thus eliminating delay incident to the inspection of baggage at destination. During the year 2,157 pieces of baggage were inspected and sealed under this arrangement.

A record of the number of containers of fruits and vegetables inspected and certified for shipment to the mainland appears in table 35.

TABLE 34.—*Number of containers of fruits and vegetables moving from Puerto Rico to the mainland, inspected and certified under Quarantine No. 58, fiscal year 1933*

Item	Inspected and certified during—												
	July	August	September	October	November	December	January	February	March	April	May	June	Total
Avocados	1	6	6	1									14
Bananas (bunches)	47	52						1	1			2	103
Celery root	15												15
Chayotes	5		4	1		21	43	43	22	1			140
Citrons		2		2		1			1	8			14
Cucumbers			3		80	3,527	6,178	8,137	1,965	672			20,562
Cucumbers (Angola)								4					4
Dasheens	15					9	42	76	54	6			202
Eggplants							10	103	316	346			775
Ginger root	58	14	4	3		1	11		1	1		27	120
Grapefruit	15,509	30,727	125,034	83,175	5,555	2,864	401	2,999	1,536	1,269	595	186	269,850
Lemons		14		25	14								53
Lerenes								2		7			9
Lima beans						61	101	92	116	1			371
Limes	36	193	136	2	11	11		1			5	26	421
Mixed (fruits and vegetables)	2	2		4	1	21	12	4	5	3			54
Oranges	74	195	300	2,015	2,044	4,794	1,459	2,352	459	4	2	1	13,699
Oranges (sour)	1						385						386
Peas (garden)						212	19	171	170	56			628
Peppers	26	11	8		5	277	657	624	448	64	17	2	2,139
Peppers (hot)						2	2	21	21	17	14		77
Pigeon peas					66	1,884	1,448	1,122	427	7			4,954
Pineapples	14,426	9,285	2,773	1,769	4,314	4,437	2,928	16,192	39,960	68,809	170,400	58,366	393,659
Potatoes												1	1
Pumpkins	65	23	67	30	6	129	82	15	31	8	20		476
Quenepas	67	30											97
Squash	3				10	908	1,532	1,072	117	1			3,643
String beans						6	13	103	21				143
Sweet corn							1	2					3
Tamarinds								2		3			5
Tangerines					152	8	122						282
Tomatoes						967	966	1,318	1,561	358			5,170
Watercress								1					1
Watermelons						19	7		32	2		14	74
Yautias	16												16
Total	30,366	40,554	128,335	87,027	12,258	20,159	16,419	34,457	47,264	71,643	171,053	58,625	718,160
Certificates	243	239	418	253	101	231	187	191	138	151	224	180	2,556

TABLE 35.—*Number of containers of fruits and vegetables inspected and certified for shipment from Hawaii to the mainland, fiscal year 1933*

Month	Bananas[1]	Pineapples	Taro	Coconuts	Ginger root	Lily root[2]	Permits issued
July	3,606	5,758	17	69	0	87	118
August	3,357	2,256	301	7	119	102	101
September	5,404	3,131	195	178	107	103	107
October	5,834	2,085	0	48	17	97	75
November	8,434	3,125	2	349	187	152	95
December	6,901	4,046	51	278	420	198	121
January	6,738	4,209	0	239	20	156	89
February	7,686	5,431	7	8	26	130	99
March	11,133	6,468	1	4	216	159	110
April	6,253	4,132	0	111	174	118	96
May	7,788	3,473	17	74	245	92	127
June	5,303	4,531	0	13	102	93	136
Total	78,437	48,645	591	1,378	1,633	1,487	1,274

[1] Bunches.
[2] This edible root (*Nelumbium nelumbo*) is also known to the trade as Lotus root.

NOTE.—In addition to the fruits and vegetables listed above, inspectors in Hawaii certified 2,915 crates of potatoes, 12 crates of onions, 3 crates of asparagus, and 5 crates of gobo for shipment to the mainland.

INSPECTION OF SPECIAL-PERMIT AND DEPARTMENTAL PLANT MATERIAL

As in previous years, all plants imported under special permit have been inspected at ports of entry designated for such material. A tabular record of special-permit importations is presented in tables 19 to 22, inclusive. The majority of such special-permit importations have been, as in former years, inspected at Washington, D.C., and these together with departmental importations and distributions from Washington, including domestic plants entering and leaving the District of Columbia, are inspected and certified for shipment at the Department inspection house, in the nursery, or in freight, express, or post offices. A summary of the inspections made at Washington, D.C., is given in table 36.

TABLE 36.—*Summary of plants and plant products offered for inspection in the District of Columbia, fiscal year 1933*

Material inspected	Foreign	Domestic	Fumigated	Otherwise treated	Infested with insects	Infected with diseases
Lots of seeds (departmental)	2,883	4,035	2,981	573	240	84
Plants, cuttings, bulbs, roots, rhizomes, etc. (departmental)	65,606	123,169	68,597	30,039	[1] 569	[1] 249
Miscellaneous unclassified material, other than plants and seeds (departmental)	105	192	50	139	4	1
Shipments of plants under regulation 14, Quarantine No. 37 (commercial)	847	-------	130	106	193	271
Shipments of plants and plant products under regulations 3 and 15, Quarantine No. 37 (commercial)	815	-------	306	240	34	170
Containers of domestic plants other than departmental (mail, express, freight, and truck)	-------	8,820	-------	-------	-------	-------
Shipments of plants for distribution by U. S. Botanic Garden	-------	368	1	368	94	-------
Shipments of plants by private individuals	-------	4,178	18	338	56	317
Interceptions of plants and plant products referred to Washington	950	-------	382	196	67	21
Cotton samples referred to Washington	5,336	-------	5,336	-------	-------	-------

[1] Lots.

An effort is made to inspect, in the field, plants imported under regulation 14 of Quarantine No. 37 during at least two growing seasons to determine their freedom from plant pests, particularly plant diseases, which may have escaped detection or which were in such an early stage of development as to make detection impossible at the initial inspection at the time of entry, prior to shipment to the field. Only the more recent of the importations shown in table 22 are still under the observation of the Department. During the year field inspections were made of imported plants and their increase, a total of approximately 26,000,000 plants. As a result of inspections in 1933 and those of preceding

years, a total of 36,821,485 plants were released from further observation. This total represents imported plant material and its increase produced during the two or more growing seasons it was under observation, which was found to be apparently free of important plant pests likely to become established in this country.

During the fiscal year 650 collections of plant pests were sent in for verification and determination, 461 of which were diseases and 189 insects. Among the more interesting pests found were the following: Nematodes—*Tylenchus dipsaci* in bulbous iris in California, Michigan, New York, and North Carolina and in narcissus in Maryland, New York, North Carolina, and Washington, root knot (*Heterodera marioni*) in bulbous iris Wedgewood, a new host; diseases—*Botrytis convoluta* on *Iris susiana* in California, *Hemileia oncidii* on orchid in Hawaii, mosaic or mosaiclike symptoms on azalea, camellia, dahlia, *Eremurus* spp., iris, narcissus, orchid, peony, rhododendron, and tigridia, *Puccinia iridis* on *Iris* spp. in California, and on *Iris* sp. in Louisiana, *Stagonospora curtisii* on *Nerine* spp., *Uredo nigropunctata* on orchid in Maryland, and *Urocystis colchici* in Delaware, Ohio, Pennsylvania, and Washington on *Colchicum* spp.; insects—*Bregmatothrips iridis* (thrips) on iris, *Eumerus* sp. (Syrphidae) in narcissus and *Valotta purpurea* (Scarboro-lily), *Frankliniella* sp. (thrips) on *Hemerocallis* sp. (daylily), *Lepidosaphes tuberculata* (Coccidae) on orchid, *Merodon equestris* (narcissus-bulb fly) in narcissus, and *Taeniothrips gladioli* (gladiolus thrips) on gladiolus and *Tritonia* sp.

INSPECTION OF PLANT-INTRODUCTION AND PROPAGATING GARDENS

As heretofore, plants grown and distributed by the Bureau of Plant Industry from its plant-introduction and propagating gardens were inspected and certified prior to shipment. Plants shipped from Mandan, N.Dak., Chapman Field, Fla., and Chico, Calif., were inspected by officials of the States concerned cooperating with this Bureau. Those distributed from Savannah, Ga., were examined by an inspector of this Bureau. Table 37 indicates the number of plants inspected and certified for distribution.

TABLE 37.—*Number of plants, bud sticks, cuttings, tubers, roots, and shipments of seeds examined for distribution from plant-introduction and propagating gardens, fiscal year 1933*

Station	Plants	Bud sticks, cuttings, tubers, and roots	Shipments of seeds
Bell	27,949	421	1
Chico	16,012	532	21
Chapman Field	6,021	181	94
Savannah	1,027	22	----
District of Columbia	5,838	50,449	4,298
Mandan, N.Dak	253,210	----	----
Beltsville	38	6,642	----
Total	310,095	58,247	4,414

INTERCEPTIONS OF PROHIBITED PLANTS AND PLANT PRODUCTS

A record of the number of interceptions of prohibited plants and plant products made by inspectors and collaborators of the Bureau at all ports appears in table 38. Many of these interceptions were found to harbor insect pests and plant diseases, and many others, while no infestation or infection was noted, must be considered potentially dangerous since they came from countries where pests not present in this country are known to occur. For example, 1,723 interceptions, representing 21,424 individual units of known hosts of the Mediterranean fruit fly, from countries where that insect is reported to occur, were made.

Interceptions made at footbridges, ferries, and crossings at the Mexican and Canadian border ports have all been listed as having been taken from baggage.

TABLE 38.—*Number of interceptions of contraband plants and plant products, fiscal year 1933*

Port	In baggage	In cargo	In mail	In quarters	In stores	Port	In baggage	In cargo	In mail	In quarters	In store
Baltimore	31	0	92	36	59	New Orleans	314	8	8	378	81
Bellingham	23	0	0	0	2	New York	1,370	322	572	82	19
Blaine	1,745	0	0	0	0	Nogales	2,312	0	1	0	0
Boston	331	1	194	103	3	Norfolk	10	0	0	105	65
Brownsville	1,965	0	6	0	0	Pensacola [5]	1	0	0	4	14
Brunswick [1]	0	0	0	0	1	Philadelphia	37	21	467	82	118
Buffalo	442	0	27	0	0	Port Arthur [6]	1	0	0	25	12
Calexico	2,333	0	0	0	0	Port Huron [5]	239	3	0	0	0
Charleston	3	1	0	116	9	Portland, Oreg.	2	0	2	1	7
Chicago	0	4	555	0	16	Presidio	131	0	0	0	0
Columbus [2]	83	0	0	0	0	Providence [7]	63	1	0	0	0
Corpus Christi	0	0	0	7	0	Puerto Rico (all ports)	162	1	0	3	1
Del Rio	498	0	0	0	0	Rio Grande City	60	0	0	0	0
Detroit [3]	564	59	245	0	0	Roma	278	0	0	0	0
Douglas	508	0	0	0	0	St. Paul [8]	0	0	203	0	0
Eagle Pass	1,994	0	0	0	0	San Diego [5]	10	7	0	8	42
El Paso	6,192	0	118	0	0	San Francisco [5]	284	29	50	457	148
Fabens	176	0	0	0	0	San Pedro [5]	33	6	0	18	51
Galveston	0	4	0	54	19	San Ysidro	6,775	0	0	0	0
Gulfport [4]	0	0	0	5	3	Sasabe	177	0	0	0	0
Hidalgo	722	0	0	0	0	Savannah	1	0	0	41	4
Honolulu [5]	724	145	108	0	4	Seattle	105	1	51	0	1
Houston	35	2	0	8	25	Tampa [5]	2	0	1	5	11
Jacksonville [5]	0	0	19	6	25	West Palm Beach [5]	0	0	0	11	20
Key West [5]	375	0	0	92	14	Ysleta	244	0	0	0	0
Laredo	3,872	0	18	0	0	Zapata	17	0	0	0	0
Los Angeles [5]	0	0	114	0	0						
Mercedes	343	0	0	0	0	Total	36,494	633	2,885	2,141	863
Miami [5]	624	14	31	432	36						
Mobile	7	4	2	62	53						
Naco	276	0	1	0	0						

[1] Work handled by inspector stationed at Savannah, Ga.
[2] This port closed June 14, 1933.
[3] Interceptions in baggage are recorded at 1 customs station only, and the number reported represents only part of the total for Detroit.
[4] Work handled by inspectors stationed at Mobile, Ala.
[5] Collaborators stationed at these ports.
[6] Includes interceptions made at Beaumont and Sabine, Tex., and Lake Charles, La.
[7] Work handled by inspectors stationed at Boston.
[8] Records cover the period October 1932 to June 1933, inclusive.

PESTS INTERCEPTED

During the fiscal year the inspectors and collaborators of the Bureau collected from foreign plants and plant products insects belonging to 958 recognized species and others distributed among 789 genera and families, fungi and bacteria belonging to 175 recognized species, nematodes belonging to 10 recognized species, and numbers of interceptions of diseases caused by fungi, bacteria, nematodes, or other agents that could be referred to family, genus, or other group only. Many of these interceptions were of considerable economic or scientific importance.

A total of 21,190 interceptions of insects and plant diseases were made during the fiscal year 1933. A summary of these interceptions appears in table 39.

TABLE 39.—*Number of interceptions of insects and plant diseases made during fiscal year 1933*

Port	Cargo		Stores		Baggage		Quarters		Mail		Total	
	Insects	Diseases	Insects	Diseases	Insects	Diseases	Insects	Diseases	Insects	Diseases	Insects	Diseases
Baltimore	25	8	77	113	10	5	26	9	20	8	158	143
Bellingham	14	7	16	5	0	0	0	0	0	0	30	12
Blaine	1	0	0	0	20	4	0	0	0	0	21	4
Boston [1]	94	71	279	264	94	27	64	15	64	39	595	416
Brownsville	24	1	0	0	273	9	34	0	0	0	331	10
Buffalo	1	29	0	0	0	1	0	0	2	0	3	30
Calexico	12	2	0	0	10	2	0	0	0	0	22	4
Charleston	420	3	28	77	0	0	4	8	0	0	452	88
Chicago	8	4	0	2	0	0	0	1	15	10	23	17
Columbus [2]	0	0	0	0	0	0	0	0	0	0	0	0
Corpus Christi	1	0	27	45	0	0	2	0	0	0	30	45
Del Rio	0	0	0	0	2	0	0	0	0	0	2	0
Detroit	25	123	0	0	1	0	0	0	23	27	49	150
Douglas	4	2	0	0	11	3	0	0	0	0	15	5
Eagle Pass	42	9	0	0	77	30	0	0	0	0	119	39
El Paso	60	33	0	0	133	162	1	0	5	7	199	202
Fabens	0	0	0	0	1	2	0	0	0	0	1	2
Galveston	16	1	60	59	0	0	1	3	0	0	77	63
Hawaii	472	1	10	0	59	0	16	0	280	6	837	7
Hidalgo	1	0	0	0	10	0	0	0	0	0	11	0
Houston	16	2	5	16	2	2	0	0	0	0	23	20
Jacksonville [3 4]	3	1	9	161	0	0	0	1	8	4	20	167
Key West [3 4]	0	0	6	4	22	0	2	2	0	0	30	6
Laredo	229	8	1	0	87	2	0	0	0	0	317	10
Los Angeles [3 4]	13	0	0	0	0	0	0	0	39	0	52	0
Miami [3 4]	7	1	15	2	63	1	59	1	2	2	146	7
Mobile [5]	264	12	121	123	7	2	15	3	0	0	407	140
Naco	4	1	0	0	36	8	0	0	0	0	40	9
New Orleans	334	47	101	155	31	7	75	16	11	1	552	226
New York	671	259	234	140	206	43	22	1	15	21	1,148	464
Nogales	1,477	801	4	6	123	48	0	1	0	1	1,604	857
Norfolk	17	11	62	191	0	0	27	15	0	0	106	217
Pensacola [3 4]	4	1	54	93	0	0	7	2	0	0	65	96
Philadelphia	398	287	394	828	57	19	87	70	364	191	1,300	1,395
Port Arthur [6]	7	1	6	4	0	0	2	0	0	0	15	5
Portland, Oreg	4	1	2	3	0	0	1	0	0	0	7	4
Presidio	5	0	0	0	2	2	0	0	0	0	7	2
Rio Grande	0	0	0	0	1	0	0	0	0	0	1	0
Roma	0	0	0	0	3	0	0	0	0	0	3	0
St. Paul	0	0	0	0	0	0	0	0	4	0	4	0
San Diego [3 4]	4	0	14	1	3	0	4	0	4	0	29	1
San Francisco [3 4]	2,576	33	449	353	313	8	420	9	317	42	4,075	445
San Juan	42	6	12	0	3	2	4	0	2	0	63	8
San Pedro [3 4]	326	0	159	5	66	0	24	0	0	0	575	5
San Ysidro	5	2	0	0	8	3	0	0	0	0	13	5
Sasabe	0	0	0	0	1	0	0	0	0	0	1	0
Savannah	16	0	18	81	0	1	9	2	0	0	43	84
Seattle	86	30	45	40	38	12	42	21	10	6	221	109
Tampa [3 4]	0	0	0	12	0	1	0	0	0	0	0	13
Thayer	0	0	0	0	8	0	0	0	0	0	8	0
Washington, D.C	274	256	0	0	0	1	0	0	794	466	1,068	723
West Palm Beach [3 4]	0	0	0	3	0	0	4	1	0	0	4	4
Ysleta	0	0	0	0	1	2	0	0	0	0	1	2
Zapata	0	0	0	0	1	0	0	0	0	0	1	0
Miscellaneous	1	0	0	0	0	0	0	0	3	1	4	1
Total	8,003	2,054	2,208	2,786	1,783	409	952	181	1,982	832	14,928	6,262

[1] Includes interceptions at Providence, R.I.
[2] Closed June 10, 1933.
[3] Collaborators stationed at these ports.
[4] California and Florida interception figures refer to numbers of pests intercepted, while figures for other ports refer to numbers of lots of infested and infected material, each lot often containing several pests.
[5] Includes interceptions at Gulfport, Miss.
[6] Includes interceptions made at Beaumont and Sabine, Tex., and Lake Charles, La.

NOTE.—Inspectors stationed at Puerto Rico made 27 interceptions of insects and 5 interceptions of plant diseases during their field and packing-house inspection of fruits and vegetables for shipment to the mainland.

CERTIFICATION FOR EXPORT

The demand for inspection and certification of fruits and vegetables and nursery stock for shipment to foreign countries increased to a marked degree during the fiscal year 1933. Five thousand seven hundred and sixty-six shipments, representing 2,464,321 containers, were inspected and certified. This represents an in-

crease over last year of approximately 71 percent in the number of shipments certified and approximately 210 percent in the number of individual containers.

The more important commodities inspected and certified were: Apples, 2,242 shipments, consisting of 1,225,428 boxes, 90,110 barrels, and 39,543 baskets; pears, 1,065 shipments, consisting of 663,592 boxes, 37,644 baskets, and 527 barrels; potatoes, 791 shipments, consisting of 159,058 bags, 8,402 barrels, and 43 crates and baskets; miscellaneous fruits and vegetables, 899 shipments, consisting of 96,406 packages; and nursery stock, including seeds, 292 shipments, consisting of 846 lots.

Through the cooperation of the Bureau of Agricultural Economics, most of the apples and pears were inspected at shipping point by Federal-State inspectors, and certified at the port of export on the basis of such inspection.

A charge of $1 was made for each certificate issued, and all fees collected were covered into the Treasury as miscellaneous receipts.

QUARANTINE CHANGES

Various changes made during the year affecting foreign plant quarantines, among which the fruit and vegetable quarantine of Puerto Rico is included for practical enforcement reasons, are here summarized.

The avocado fruit order of February 27, 1914, together with its regulations, was revoked, effective July 1, 1932, thus allowing avocado fruits to come under the fruit and vegetable Quarantine No. 56, and avocado nursery stock to fall under the provisions of the nursery stock, plant, and seed Quarantine No. 37.

Quarantine No. 19, on account of citrus canker and other citrus diseases, was modified, effective July 1, 1932, to release citrus seeds from a prohibited status and thus permit their entry under the regulations of Quarantine No. 37.

Regulation 3 of Quarantine No. 37, the nursery stock, plant, and seed quarantine, was revised, effective July 1, 1932, to permit entry of all species of *Fritillaria*; to permit the entry of mango seeds from North America, Central America, South America, and the West Indies; to allow entry for propagation purposes of certain plant materials admitted for consumption under Quarantine No. 56; to provide for the entry of oriental fruit cuttings, scions, and buds, released from a prohibited status by the revocation of Quarantine No. 44; and to provide likewise for citrus seeds excepted from Quarantine No. 19.

Regulation 7 of this quarantine was also revised, effective July 1, 1932, to waive the requirement of freedom from sand, soil, and earth in connection with Canadian-grown plants.

A considerable liberalization of the restrictions on the entry of corn and related plants was brought about in a revision, effective March 1, 1933, of the regulations of Quarantine No. 41, governing the importation of Indian corn or maize, broomcorn, and seeds of related plants.

By the revocation of Quarantine No. 44, effective July 1, 1932, provision was made that stocks, cuttings, scions, and buds of fruits from the Orient should hereafter be enterable under Quarantine No. 37.

The seed- or paddy-rice Quarantine No. 55, was revised, effective July 1, 1933, to include rice straw and rice hulls.

By amendment no. 5 to regulation 2 of the fruit and vegetable Quarantine No. 56, effective July 15, 1932, it was made possible to relax restrictions in reference to a particular portion or area of a foreign country when it is considered that importation from that portion can be safely permitted.

Amendment no. 1 to the regulations of Quarantine No. 58, the fruit and vegetable quarantine of Puerto Rico, effective January 1, 1933, affected regulation 3 only, and provided for the admission to the rest of this country of a considerable number of fruits and vegetables additional to the limited number listed in the original regulation.

A new quarantine, no. 69, on packing materials, came into effect on July 1, 1933. This quarantine prohibits the entry as packing of certain plant materials, of which rice straw is the most important, and brings under a moderate type of restriction several other materials, among which cereal straw other than rice, and grasses and hay, are the most commonly used for packing purposes.

Amendment no. 1 to this quarantine, effective July 1, 1933, permits exceptions to be made in the case of prohibited materials when these have been so prepared, manufactured, or processed that their entry is judged to involve no pest risk.

TECHNOLOGICAL DIVISION

The work of the Technological Division during the fiscal year 1933 was carried on cooperatively with other divisions and projects of the Bureau on problems relating to the sterilization of plants and plant products.

A new form of cottonseed sterilizer for destroying pink-bollworm larvae in cottonseed and adapted to continuous operation in handling the seed as it comes through the gin was designed, built, and tested. The machine is so constructed that it can be heated by steam or, if a boiler is not available, a vaporizing burner of the type in common use for commercial operation can be used as a source of heat. In the tests the sterilizer was found to be efficient and economical and readily heated the seed to a temperature of 145° F., the temperature required for sterilization.

A method of installing thermograph bulbs in cottonseed sterilizers was developed which allows a more accurate determination of the temperature of the seed and also increases the efficiency of the machine. A special stream-lined bracket for holding the bulb was designed and installed in the conveyor in such a way that the bulb is buried in a mass of seed whenever the sterilizer is in operation. This mass of seed prevents the escape of steam from the conveyor and results in more efficient operation. The cost of sterilization is reduced, as much less steam is used to perform the operation.

In cooperation with one of the large cotton companies, a method of treating cotton lint was developed which consists in passing the lint through heavy steel rollers as it comes from the gins and before it reaches the press box. Careful tests showed that such treatment is effective in crushing all seeds which may be in the lint so that any pink bollworms present will be destroyed. The equipment costs approximately $250 installed, and the operating costs are about 1 cent per bale, as compared with a cost of $1 to $2 per bale for fumigation.

A method for treating hardy perennial plants in pots was worked out in cooperation with one of the large nurseries. The concentration of lead arsenate sufficient to kill the larvae of the Japanese beetle, but low enough so that the plants would not be injured, was determined. A treatment was developed which is effective in destroying the larvae and which can be applied to most perennials without injury. In the tests with plants, only 6 varieties out of 61 showed injury. Several thousand individual plants were included in these tests.

Analyses of the soil for lead arsenate in plots of growing plants, heeling-in areas, and plunging frames were made to determine the amount necessary to add to bring these areas up to the 1,500 pounds in the first 3 acre-inches. This lead arsenate content is necessary to insure that no live Japanese beetle larvae are present, so that the plants may be shipped outside the regulated area without danger of spreading the infestation. In all, 872 samples from 392 plots of growing plants, 317 plunging frames, and 34 heeling-in areas were analyzed. These comprised a total of 5,726,153 square feet, of which 3,358,271 square feet needed the addition of some lead arsenate to bring the content up to 1,500 pounds in the first 3 acre-inches. Analyses were made of plots in 22 different nurseries, of which 1 was in Delaware, 16 in New Jersey, and 5 in Pennsylvania.

A treating tank for applying the hot-water treatment to bulbs, as required by both domestic and foreign plant quarantines, was designed, built, and tested, and proved to be more efficient than many of the tanks now in commercial use. Plans have been prepared for the construction of this equipment, and they will be furnished to bulb shippers when desired.

A number of alterations and additions have been made to the car-fumigating houses along the Mexican border. Vacuum-fumigating equipment has been installed at four ports to treat small shipments of infested or suspected material; new doors have been built; a new roof was applied to the fumigation house at Nogales, Ariz., and numerous minor repairs have been made.

Considerable service work and work of an advisory nature has been done with the other projects in the Bureau.

TERMINAL INSPECTION OF MAIL SHIPMENTS OF PLANTS AND PLANT PRODUCTS

During the fiscal year, the list of terminal inspection points in California for the inspection of plants and plant products, under the authority of the act of March 4, 1915, was revised, as were also the lists of plants and plant products subject to such inspection in Florida and Georgia. The details of these revisions are given in the Service and Regulatory Announcements of this Bureau.

Louisiana and Puerto Rico inaugurated terminal inspection during the year, while three States, Idaho, Wyoming, and Georgia, found it necessary, on account of lack of funds, to discontinue such inspection.

Terminal inspection is now maintained by the following: California, Arizona, Montana, Florida, Washington, Arkansas, the District of Columbia, Mississippi, the Territory of Hawaii, Utah, Oregon, Oklahoma, Louisiana, and the Territory of Puerto Rico.

CONVICTIONS AND PENALTIES IMPOSED FOR VIOLATIONS OF THE PLANT QUARANTINE ACT

The following convictions and penalties imposed for violations of the Plant Quarantine Act were reported to the Bureau during the year:

Avocado order: Two convictions, with 1 fine of $25 and 1 jail sentence of 5 months.

European corn-borer quarantine (domestic): One conviction, with fine of $50.

Japanese-beetle quarantine: Four convictions, with fines aggregating $105, and, in one instance, defendant was placed on probation for 6 months.

Quarantines affecting Mexican plant products: Fines aggregating $156.85 were imposed by customs officials on the Mexican border against 37 persons caught attempting to smuggle in from Mexico prohibited plants and plant products.

Quarantines affecting Canadian plant products: Fines aggregating $38.90 were imposed by customs officials on the Canadian border against eight persons caught attempting to smuggle in from Canada prohibited plants and plant products.

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REPORT OF THE CHIEF OF THE BUREAU OF PUBLIC ROADS, 1933

United States Department of Agriculture,
Bureau of Public Roads,
Washington, D.C., September 1, 1933.

Sir: I submit herewith the report of the Bureau of Public Roads for the fiscal year ended June 30, 1933.

Respectfully,

Thomas H. MacDonald, *Chief.*

Hon. Henry A. Wallace,
Secretary of Agriculture.

The mileage of Federal-aid road construction during the fiscal year 1933 was less than the mileage constructed in the preceding year but greater than in any other year. The aggregate length of the projects completed was 13,255.3 miles, of which 8,503.3 miles were included in initial-construction projects, 4,700.5 miles in stage construction, and 51.5 miles in reconstruction projects.

The projects inaugurated during the year reduced to little more than $15,000,000 the unobligated balance of all Federal-aid appropriations thus far authorized, and to slightly more than $3,000,000 the special emergency appropriation of $120,000,000 made less than a year previous.

For the first time in 17 years the fiscal year ended without definite provision by Congress for the continuance of the program of Federal-aid road construction. In place of the usual authorization, provision was made in the National Industrial Recovery Act, approved June 16, 1933, for the construction of highways as a means of furnishing employment during the fiscal year 1934. For this purpose there was appropriated $400,000,000 to be expended on Federal-aid roads and extensions thereof into and through cities and on secondary and feeder roads in all States, and an additional sum of $50,000,000 for forest and park roads and roads in Indian reservations and through public lands.

Rules and regulations governing the expenditure of the $400,000,000 appropriation were issued June 23, 1933.

EMERGENCY APPROPRIATIONS AND EMPLOYMENT

Under the provisions of the Emergency Relief and Construction Act of July 21, 1932, $120,000,000 was made available for emergency-construction work on the Federal-aid highway system. The act required apportionment of the appropriation among the several States and Hawaii in accordance with the regular Federal-aid formula, to be used as a temporary advance, and in lieu of State funds, to match the regular annual Federal-aid funds available to the States. It was further provided that the sums advanced should be reimbursed to the Federal Government by deduction from future Federal-aid appropriations over a period of 10 years commencing with the fiscal year 1938.

The construction season of 1932 was far advanced when these funds became available. As a result the rate of expenditure was at first considerably slower than it would have been had the appropriation been provided earlier in the year. With the object of insuring prompt expenditure and quickly increased employment the act stipulated that the money should be advanced only for work performed before July 1, 1933. It soon became apparent that expenditure of the entire appropriation by the date set would be virtually impossible, and the time of availability was extended to January 1, 1934, by an amendment in the Agricultural Appropriation Act, approved March 3, 1933.

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As shown by table 1, actual disbursements of these funds to the States to June 30, 1933, the original terminal date, amounted to $62,131,961.24. An additional amount, estimated at $23,122,000, had been earned by the completion of work, which will be paid on receipt of the vouchers of the State highway departments.

TABLE 1.—*Emergency construction apportionment, and amounts paid to States for fiscal year 1933, and unobligated balance of apportionment, June 30, 1933*

State	Emergency construction apportionment	Paid to States during the fiscal year 1933	Unobligated balance of apportionment on June 30, 1933
Alabama	$2,558,229	$1,463,650.73	$115.57
Arizona	1,760,771	1,227,945.74	22,765.87
Arkansas	2,101,182	798,562.89	54,222.91
California	4,667,188	3,396,566.14	190,944.52
Colorado	2,258,613	1,178,167.24	288,368.28
Connecticut	778,806	199,301.99	5,822.36
Delaware	600,000		
Florida	1,624,752	999,893.39	2,417.96
Georgia	3,123,298	2,383,353.97	95,528.97
Idaho	1,505,912	759,959.46	101,608.12
Illinois	5,082,847	1,378,516.99	9,583.51
Indiana	3,058,980		252,947.45
Iowa	3,171,504	2,403,987.98	84,421.60
Kansas	3,265,048	2,064,898.57	268,110.53
Kentucky	2,264,637	965,178.40	45,581.41
Louisiana	1,745,559	1,158,469.56	
Maine	1,067,079	390,016.06	29,067.60
Maryland	1,019,570	427,495.73	
Massachusetts	1,716,612	767,048.69	
Michigan	3,779,706	1,798,198.57	89,446.58
Minnesota	3,368,559	1,736,320.72	
Mississippi	2,160,164	658,279.26	55,479.51
Missouri	3,753,453	1,570,921.22	4,458.66
Montana	2,525,071	1,637,171.24	2,840.77
Nebraska	2,544,773	2,076,085.45	20,553.11
Nevada	1,575,756	959,697.77	265,660.66
New Hampshire	600,000	226,423.26	89,000.48
New Jersey	1,657,733	859,687.32	
New Mexico	1,965,473	1,669,349.87	38,274.28
New York	6,059,238	2,527,212.34	
North Carolina	2,888,251	1,628,859.21	
North Dakota	1,933,901	873,888.73	124,186.74
Ohio	4,490,175	2,079,240.12	254,412.21
Oklahoma	2,888,723	1,184,770.09	337,047.03
Oregon	2,001,740	946,288.34	246.54
Pennsylvania	5,267,060	2,249,237.37	22,800.00
Rhode Island	600,000	388,068.04	
South Carolina	1,666,755	1,062,821.18	14,070.08
South Dakota	2,004,573	1,217,751.66	1,349.19
Tennessee	2,605,160	1,741,663.14	45,000.00
Texas	7,664,621	3,369,028.47	25,434.98
Utah	1,395,331	628,690.11	8,812.78
Vermont	600,000	258,344.56	200.00
Virginia	2,256,178	1,163,685.76	234,125.19
Washington	1,920,470	1,206,890.62	117,757.76
West Virginia	1,323,912	869,397.98	43,927.28
Wisconsin	2,991,076	2,003,172.96	1,252.96
Wyoming	1,541,561	1,084,939.98	9,682.73
Hawaii	600,000	492,862.37	492.31
Total	120,000,000	62,131,961.24	3,258,018.49

Of the total appropriation only $3,258,018.49 remained unobligated at the end of the year, and three fourths of this amount was credited to 11 States. Nine States—Delaware, Louisiana, Maryland, Massachusetts, Minnesota, New Jersey, New York, North Carolina, and Rhode Island—had obligated the total amounts of their apportionments, and several other States had negligible balances.

Of the funds obligated, $4,502,467.38 had been paid on projects completed and fully paid for; $9,032,380.76 had been allotted to projects which had been completed, but for which the final payment had not been made; $98,477,405.61 was obligated to projects that were under construction at the end of the year, and $4,729,727.76 to projects that had been approved for construction.

The effect of the emergency appropriation upon employment afforded by highway work is shown in table 2. The table shows in adjoining columns the numbers of men employed in each month of the fiscal years 1932 and 1933 on all Federal and Federal-aid construction and on all Federal and State road work including

State-maintenance operations. The Federal-employment figures include the relatively small numbers of men employed on national-forest and national-park road construction in addition to much larger numbers employed on Federal-aid and emergency Federal-aid projects.

TABLE 2.—*Comparison of employment during the fiscal years 1932 and 1933 on all Federal and Federal-aid highway construction and on all Federal and State road work, including State maintenance operations, by months*

Month	Men employed on all Federal and Federal-aid highway construction		Total men employed on all Federal and State highway construction and maintenance	
	Fiscal year 1932	Fiscal year 1933	Fiscal year 1932	Fiscal year 1933
July	164,708	81,042	385,349	305,372
August	151,418	89,346	389,949	333,403
September	116,100	122,193	356,617	374,405
October	88,869	124,106	330,104	373,246
November	62,466	129,933	289,316	371,667
December	35,991	98,271	244,971	290,465
January	29,518	75,498	229,189	266,443
February	26,673	78,215	218,218	255,256
March	28,008	95,704	211,549	279,213
April	42,205	122,256	245,843	299,882
May	59,008	139,831	259,615	330,138
June	71,772	152,276	280,636	359,605

The effects of two emergency appropriations are noticeable in table 2. In July and August 1931—the first 2 months of the fiscal year 1932—the $80,000,000 emergency appropriation of December 20, 1930, was still in course of expenditure. In the corresponding months of the fiscal year 1933, the expenditure of the $120,000,000 emergency appropriation of July 21, 1932, had not begun, and the regular Federal-aid appropriations were the only Federal funds available. A comparison of the employment on Federal projects in these 2 months of one fiscal year with the same months of the other shows that employment in the fiscal year 1932 period when the first emergency appropriation was being expended, was almost twice that of the similar 1933 period when only the regular Federal-aid appropriation was available.

The figures for total Federal and State employment in the last two columns of the table show that the additional employment made possible by the Federal emergency appropriation in the 2 months of the fiscal year 1932 was effective in increasing total employment. In July 1931, employment on Federal projects exceeded the similar employment in July 1932 by 83,666 men. The corresponding difference in total employment was 79,977. In August 1931 the Federal employment exceeded similar employment in August 1932 by 62,072, and the corresponding difference in total employment was 56,546. It is apparent that the greater total employment on all Federal and State highway work in July and August 1931, as compared with the same months of 1932, was due very largely to the Federal emergency appropriation.

In the remaining months of the 2 years the situation is reversed, and the greater employment figures are without exception recorded in the fiscal year 1933. In this connection, it will be recalled that the availability of the $80,000,000 emergency appropriation terminated on September 1, 1931, and that the $120,000,000 appropriation became available on July 21, 1932. Federal employment fell off sharply after August 1931 and increased markedly in September 1932. For every month after the latter month the effect of the $120,000,000 appropriation is clearly indicated by the excess of employment over the corresponding month of the preceding year when no emergency appropriation was available; and the average increase on Federal and Federal-aid work was reflected in large part in an increase in total employment.

During the last 10 months of the fiscal year 1932 the total Federal employment was 560,610 man-months. In the corresponding period of the fiscal year 1933 there was a total employment of 1,138,283 man-months, a gain, due mainly to the $120,000,000 emergency appropriation, of 577,673 man-months, or more than 100 percent of the 1932 total.

In the same two 10-month periods the total Federal and State employment was 2,666,058 man-months in 1932 and 3,200,320 man-months in 1933. The 1933 gain, 534,262 man-months, is slightly less than the gain in Federal and Federal-aid work, indicating that the employment increase provided for by the Federal emergency appropriation may have been partly offset by a drop in the employment possible with State funds.

Table 2 shows that Federal and Federal-aid work gave employment throughout the winter of 1932–33 to more than twice as many men as had been employed on the same kind of work the preceding winter, and it also shows that this additional Federal employment had the effect of raising the total winter employment on highway work. From the sharp increase in Federal employment in September 1932, less than 2 months after the passage of the Emergency Relief and Construction Act, it is apparent that the benefits of the emergency funds were very quickly felt by labor.

PROGRESS IN FEDERAL-AID ROAD CONSTRUCTION

Initial improvements were made during the fiscal year on 8,503.3 miles of the Federal-aid highway system; advanced stages of improvement were constructed on 4,700.5 miles; and 51.5 miles previously improved were reconstructed. The total mileage constructed was therefore 13,255.3 miles. This is less than the 15,997.2 miles constructed during the preceding year but exceeds the mileage constructed in any other year.

As explained in the report for the fiscal year 1932 the improvements classed as completed and included in the above total mileage figures are not only physically completed but have also been paid for by the Federal Government to the full extent of its obligation. In addition to these projects, there were others on which at the end of the year all construction work was completed to the satisfaction of the Bureau, and only the final payment by the Federal Government remained to be made before classifying them as completed. They are separately classified only because, until the final voucher has been paid, it is not possible to report exactly the total cost and Federal payment. In projects of this class there were at the end of the fiscal year 1933, 2,171.6 miles of initial construction, and 1,166.9 miles of stage construction, a total of 3,338.5 miles, exceeding by 407.6 miles the total similarly classified in the fiscal year 1932.

At the close of the year, construction of initial improvements was in progress on 8,397.4 miles, and other initial improvements had been approved for 522.5 miles. Stage construction was in progress on 3,970.3 miles already initially improved with Federal aid, and similar advanced improvements had been approved for 236.7 miles. In addition, 15.9 miles previously improved were in process of reconstruction.

The active construction program at the close of the year involved a total of 12,383.6 miles, as compared with a total of 10,511.9 miles the year previous. The increase this year is attributable to the $120,000,000 appropriation made by the Emergency Relief and Construction Act of 1932. On the other hand, the additional mileage on which improvements have been approved, totaling only 759.2 miles at the close of last year, is much smaller than the 4,076.2 miles at the corresponding stage of the year before. This is explained by the near approach to complete obligation of all available Federal-aid and emergency advance funds at the close of last year.

The total mileage on which initial improvements had been constructed and final payment made by the Federal Government up to the end of the fiscal year 1933 was 109,683.4. In addition there were 2,171.6 miles which were constructed and opened to traffic but not yet completely paid for on the part of the Federal Government. Initial improvements had, therefore, been physically constructed with Federal aid on 111,855 miles of the system on June 30. At that time, however, 3,986.2 miles included in the above were undergoing stage construction or reconstruction and were temporarily removed from the mileage open to travel, so that the mileage classified as completed on June 30, 1933, was only 107,868.8 miles, which is a net increase of 6,836.7 miles over the corresponding mileage on June 30, 1932. The location of this mileage by States is shown in table 12. Its classification by types, as built with Federal aid, and its location are shown in table 17.

STAGE CONSTRUCTION

Although the mileage of stage construction during the year was less than the mileage during the preceding year by about 225 miles, the ratio of stage construction to initial construction increased sharply. The 4,700.5 miles on which stage construction operations were completed represented 55.3 percent of the mileage of initial construction, as compared with 44.6 percent, the corresponding ratio of the year immediately preceding.

As explained in previous reports, works classified as stage construction are supplementary improvements, paid for in part with Federal aid, of roads previously improved to lesser degree as Federal-aid projects. In most instances it is work deliberately deferred at the time of original improvement, and definitely forecast and agreed upon as a future necessity in the original agreements with the State highway departments. Many such projects involve the deferred surfacing of roads previously graded and drained. In no case is the total Federal expenditure on any project increased by the additional allotment beyond the limit of payment per mile fixed by law.

It may be necessary to explain again, as in previous reports, that the plan of stage construction is a considered policy designed to permit extension of some degree of improvement as rapidly as possible with the funds annually available to the entire Federal-aid system with provision for further and more adequate improvement as funds subsequently are made available. As shown by table 3, the ratio of such supplementary work to initial improvements has steadily increased since it was first recorded in 1923, when it was only 1.2 percent. This increase from year to year is the natural result of the shrinkage of unimproved mileage within the system and the development of the occasion and opportunity for further improvement of the previously constructed mileage.

TABLE 3.—*Mileage of initial construction, stage construction, and reconstruction projects completed and final payment made, by fiscal years 1923–33*

Fiscal year	Mileage of initial construction completed and paid for	Stage construction completed and paid for		Reconstruction completed and paid for		Mileage of total construction
		Mileage	Percentage of initial construction	Mileage	Percentage of initial construction	
1923	9,940.5	117.8	1.2			10,058.3
1924	9,145.6	280.7	3.1			9,426.3
1925	9,437.1	495.3	5.3			9,932.4
1926	10,533.3	783.9	7.4			11,317.2
1927	8,413.5	1,376.6	16.4			9,790.1
1928	8,532.2	2,088.8	24.5			10,621.0
1929	7,267.4	2,069.7	28.5			9,337.1
1930	6,675.4	1,988.0	29.8	18.8	0.3	8,682.2
1931	7,938.8	3,082.5	38.8	12.0	.2	11,033.3
1932	11,036.9	4,925.1	44.6	35.2	.3	15,997.2
1933	8,503.3	4,700.5	55.3	51.5	.6	13,255.3

Detailed information in regard to stage-construction work completed, in progress, and approved will be found in tables 13 to 16 and 22 to 25. The mileage classified as graded and drained consists mainly of partial relocations of previously improved roads on which surfacing has not yet been added. Such relocations are in nearly all instances needed to reduce curvature permitted in the original improvements.

The effect of stage construction as a means of raising the standard of improvement of the system will be seen by comparing tables 18 and 26, the former showing the mileage of the several types of construction completed as initial improvements during the past year and the latter the net change in the character of the total improved mileage as influenced by stage construction. Whereas, in the initial improvements completed surface construction of bituminous macadam and higher types constituted only 42 percent of the total road mileage, exclusive of

bridges and their approaches, the same high types constituted nearly 64 percent of the net increase in improved mileage. It will also be noted that the low-cost bituminous mixed surfaces and surface-treated macadam and gravel, which are intermediate types and which constituted 37 percent of the net increase, made up less than 10 percent of the mileage initially improved during the year. On the other hand, graded and drained roads and low-type untreated surfaced roads, which made up almost half of the year's initially improved mileage, appear in the table of net changes as an aggregate negative quantity, i.e., the mileage of these low types at the close of the year, in consequence of supplementary stage improvements, was less than at the end of the preceding year.

RECONSTRUCTION

During the year 51.5 miles of road previously improved with Federal aid were reconstructed and final payment of the Federal share of the cost made. As the year closed there were 15.9 miles additional in course of reconstruction. The work just completed brings the total of mileage reconstructed with Federal assistance to 117.5 miles, about 0.1 percent of the total mileage built with Federal aid.

Of the total mileage thus far rebuilt with Federal aid 45.2 miles was originally of gravel surface construction. In the reconstruction 37.6 miles of these roads have been surfaced with concrete, and 7.5 miles have been improved with bituminous concrete pavements. The remaining tenth of a mile was involved in the reconstruction of a bridge and its approaches.

Of 22.7 miles, originally of bituminous-macadam surface construction, 20.1 miles have been resurfaced with concrete and 2.6 miles with bituminous concrete. Of the rebuilt sections of bituminous concrete, totaling 16.3 miles, 2.6 miles were newly surfaced with bituminous macadam and 13.7 miles with concrete; and of the 28.7 miles originally paved with concrete, 5.8 miles have been rebuilt of the same material and 22.9 miles have been topped with bituminous concrete, the old concrete being used as a base. The single project originally paved with brick on which reconstruction has been necessary is 4.6 miles in length, and the reconstruction substituted a concrete pavement for the original surface.

Full information relative to reconstruction on Federal-aid projects will be found in tables 4 to 8 and 13 to 16.

TABLE 4.—*Federal-aid projects on which reconstruction had been completed and paid during fiscal year 1933*

State	Total cost	Federal aid	Miles
Michigan	$518,260.71	$235,352.17	19.8
Nevada	362,399.44	319,009.34	13.7
Ohio	161,397.10	68,976.64	4.6
Oklahoma	296,061.07	138,515.37	11.2
Rhode Island	63,881.28	31,940.64	2.2
Total	1,401,999.60	793,794.16	51.5

TABLE 5.—*Federal-aid projects on which reconstruction was in progress on June 30, 1933*

State	Estimated total cost	Federal aid allotted	Emergency construction funds allotted	Miles
Rhode Island	$144,716.30	$30,000.00	$114,716.30	4.3
Tennessee	322,251.95	161,125.97	161,125.98	11.6
Total	466,968.25	191,125.97	275,842.28	15.9

TABLE 6.—*Federal-aid projects, by types of construction, on which reconstruction had been completed, June 30, 1933*

State	Old construction		New construction	
	Age (years)	Type	Type	Miles
Louisiana	4	Gravel, untreated	Bituminous concrete	7.5
Maine	7	Bituminous macadam	Concrete	1.9
	9	do	do	1.6
	10	do	do	3.6
	11	do	do	3.0
Maryland	13	do	Bituminous concrete	2.6
	12	do	Concrete	3.2
	13	Portland cement concrete	do	5.8
	12	Bituminous macadam	do	1.8
Massachusetts	10	Bituminous concrete	Bituminous macadam	2.6
	8	Bituminous macadam	Concrete	2.8
Michigan	12	Bituminous concrete	do	10.0
	7	Gravel, untreated	do	4.8
	8	do	do	15.0
Nevada	13	Portland cement concrete	Bituminous concrete	9.2
	11	do	do	10.2
	10	do	do	3.5
New Hampshire	12	Bituminous concrete	Concrete	1.7
	10	do	do	2.0
Ohio	13	Brick	do	4.6
Oklahoma	11	Gravel, untreated	do	2.5
	9	do	do	2.7
	12	do	do	11.2
	9	do	Bridge	.1
Rhode Island	12	Bituminous macadam	Concrete	2.2
Vermont	5	Gravel, untreated	do	1.4

TABLE 7.—*Federal-aid projects, by types of construction, on which reconstruction had been completed and paid for during the fiscal year 1933*

State	Old construction		New construction	
	Age (years)	Type	Type	Miles
Michigan	8	Gravel, untreated	Concrete	15.0
	7	do	do	4.8
Nevada	11	Portland cement concrete	Bituminous concrete	10.2
	10	do	do	3.5
Ohio	13	Brick	Concrete	4.6
Oklahoma	12	Gravel, untreated	do	11.2
Rhode Island	12	Bituminous macadam	do	2.2

TABLE 8.—*Federal-aid projects, by types of construction, on which reconstruction was in progress, June 30, 1933*

State	Old construction		New construction	
	Age (years)	Type	Type	Miles
Rhode Island	11	Bituminous concrete	Concrete	4.3
Tennessee	13	Bituminous macadam	Graded and drained	11.2
	13	do	Bridge	.4

CHANGES IN THE FEDERAL-AID HIGHWAY SYSTEM

In the last annual report the mileage of the Federal-aid system within the boundaries of national forests, Indian reservations, and other Federal reservations was reported as 5,785 miles, as determined up to the close of the fiscal year 1932. During the past year this mileage has been increased to 6,224 miles by the addition to the system of new routes, portions of which lie within the various kinds of reservations. The location, by States, of the mileage within Federal reservations is shown in table 9.

By amendment of the Federal Highway Act, approved May 21, 1928, the original 7-percent system may be increased by these mileages within Federal reservations, and such addition, together with an increase in the mileage of the system in Hawaii authorized by a special act approved February 23, 1931, raises the permissible mileage of the initial system to 207,105 miles.

TABLE 9.—*Mileage of Federal-aid highway system within Federal reservations, being the amounts by which the 7-percent limiting mileage may be exceeded in each State as of June 30, 1933*

State	Mileage within Federal reservations	State	Mileage within Federal reservations	State	Mileage within Federal reservations
Arizona	547	Minnesota	75	Pennsylvania	108
Arkansas	120	Mississippi	10	South Dakota	475
California	465	Montana	1,053	Tennessee	66
Colorado	438	Nebraska	21	Utah	69
Georgia	58	Nevada	22	Virginia	49
Idaho	558	New Hampshire	33	Washington	440
Illinois	5	New Mexico	368	West Virginia	29
Iowa	2	New York	16	Wisconsin	46
Kansas	15	North Carolina	176	Wyoming	326
Kentucky	6	North Dakota	23		
Maine	5	Oklahoma	48	Total	6,224
Michigan	57	Oregon	495		

By section 6 of the Federal Highway Act, the State highway departments were authorized, with the approval of the Secretary of Agriculture, to add to the mileage of the original 7-percent system when provision had been made for completion and maintenance of the entire original system and funds became available for the construction and maintenance of such additional mileage. This provision was amended by section 304 of the Emergency Relief and Construction Act of 1932. Under the amended legislation the State highway departments are authorized, with the approval of the Secretary of Agriculture, to increase the original 7-percent mileage of the Federal-aid system by addition of not more than 1 percent of the total mileage of their respective States when provision has been made for the completion and maintenance of 90 percent of the original 7-percent system, and thereafter to make like increases in the mileage when provision has been made for the completion and maintenance of 90 percent of the mileage previously authorized.

Under the original provision extensions of the Federal-aid system beyond the original 7-percent limit had been made in Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, and Rhode Island, the total of such extensions amounting at the close of the fiscal year 1932 to 3,335 miles. Under the new provision the system has been further extended in these States and additions have also been made in Florida, Illinois, Nevada, North Carolina, Oregon, and Pennsylvania. The total permissible extensions in the 13 States amounted at the close of the year 1933 to 9,511 miles.

The mileage of the actually designated Federal-aid system in each State, including the authorized extensions in 13 States and the mileage within Federal reservations, is given in table 12 which also shows the distribution by States of the 107,868.8 miles classified as completed on June 30, 1933.

The mileage classified as completed with Federal aid still includes a small mileage improved before 1921 and not since included in the designated Federal-aid system. These roads, if found not sufficiently important to be added to the system, are being gradually dropped and the Federal money invested in them transferred as a credit to the improvement of other roads in the system. A year

ago it was reported that the Federal-aid money originally paid for the improvement of 1,311 miles of such roads outside the system had been transferred to other roads within the system. Continuation of this procedure during the past year has returned to the Government the amount originally expended on other roads outside the system totalling 215.6 miles, and this money has been allotted to the initial or stage construction of other roads within the system.

The mileage of the Federal-aid system has also been reduced this year by reductions in the length of previously improved roads effected by relocations in the course of stage construction. The total of such reductions during the year was 39 miles.

CONSTRUCTION OF ROADS THROUGH PUBLIC LANDS AND FEDERAL RESERVATIONS

The Emergency Relief and Construction Act of 1932, appropriated an additional $2,000,000 to be expended for the survey, construction, reconstruction, and maintenance of main roads through unappropriated or unreserved public lands, nontaxable Indian lands, or other Federal reservations except national forests.

After deduction of the 2½-percent administrative allowance, the balance, amounting to $1,950,000, was apportioned among 14 States having more than 5 percent of their area in lands of the kind described. The apportionment was made in proportion to the area of such lands in the several States, as required by law.

As stated in the last annual report a previous appropriation of $3,000,000 made by the Emergency Employment Act of December 20, 1930, was apportioned, after deduction of the administrative percentage, among 13 States. In this earlier appropriation North Dakota did not share.

The total of the two apportionments thus far made for this purpose is $4,875,000, which amount has been apportioned among the several eligible States as shown in table 10. The same table also shows the progress made toward expenditure of the funds in the several States.

TABLE 10.—*Status of appropriations for roads through public lands and Federal reservations, June 30, 1933*

State	Total sum apportioned	Sums allotted to projects					Unobligated balance
		Not yet under construction	Under construction	Completed and finally inspected	Completed and final payment made	Total allotted	
Arizona	$708,169		$204,819.58		$416,328.00	$621,147.58	$87,021.42
California	416,153	$416,153.00				416,153.00	
Colorado	199,130		130,197.00			130,197.00	68,933.00
Idaho	277,896	34,852.78	64,441.37	$101,200.93	73,115.07	273,610.15	4,285.85
Montana	267,181		38,148.54		163,248.25	201,396.79	65,784.21
Nevada	1,029,597		410,299.49	140,933.98	357,097.99	908,331.46	121,265.54
New Mexico	411,309		102,776.11	137,934.17	170,598.72	411,309.00	
North Dakota	24,858		24,858.00			24,858.00	
Oklahoma	59,216		30,435.23		11,028.77	41,464.00	17,752.00
Oregon	324,082	10,000.00	92,953.90	204,876.46	10,400.00	318,230.36	5,851.64
South Dakota	103,034		65,715.00			65,715.00	37,319.00
Utah	543,796	92,713.00	124,400.00		326,683.00	543,796.00	
Washington	80,429		25,264.00		55,165.00	80,429.00	
Wyoming	430,150		79,598.00		344,586.23	424,184.23	5,965.77
Total	4,875,000	553,718.78	1,393,906.22	584,945.54	1,928,251.03	4,460,821.57	414,178.43

FEDERAL-AID FUNDS APPORTIONED, OBLIGATED, AND EXPENDED

The appropriation authorized for the fiscal year 1933 was $125,000,000. From this amount, however, it was necessary to deduct a portion of the amount advanced to the States of the emergency appropriation of $80,000,000 for work performed before September 1, 1931, as provided by the act approved December 20, 1930. The act required that the sums advanced of the emergency appropriation should be reimbursed to the Federal Government over a period of 5 years, commencing with the fiscal year 1933, by making deductions from the regular Federal-aid apportionments.

In the early fall of 1931 when it was desired to apportion the appropriation authorized for 1933 the amount of the $80,000,000 appropriation actually advanced was not known with certainty, since in many cases final vouchers for work done prior to September 1 had not been received. Accordingly, in the apportionment made October 15, 1931, the total authorized appropriation was reduced first by the 2½ percent allowed for administration and then by one fifth of the entire emergency appropriation, or $16,000,000, leaving a balance of $105,875,000 which was apportioned.

Subsequently, when the amounts of the emergency funds actually paid to the States became known, it was found that Alabama, California, Louisiana, Missouri, Nevada, Oregon, Texas, and Utah had not availed themselves of a part of the money allotted to them. Consequently, the apportionment of the 1933 Federal-aid funds was revised, and a new apportionment was certified on August 22, 1932, under which each of the above-named States received slightly increased sums, and the total apportioned sum was increased to $106,034,256.14. The amounts finally credited to the several States are shown in table 27.

Of this amount a large part had already been obligated when the fiscal year opened, the States having taken advantage of the provision of law which permits obligation of the authorized appropriation immediately upon its apportionment. In consequence there was available for allotment to new projects on July 1, 1932, only $61,720,100.60.

By subsequent obligation this balance had been reduced at the end of February 1933 to $15,745,969, and shortly thereafter it was found desirable to suspend further obligation of the money pending the formulation of a complete program of public works and unemployment relief. With this program definitely provided for by the National Industrial Recovery Act, the State highway departments were authorized to resume submission of projects, and by June 30, 1933, the unobligated balance had been reduced to $15,190,331.20. As no Federal-aid appropriation has been authorized for the fiscal year 1934, this represents the total sum that, under existing legislation, will be available as Federal aid during the ensuing year.

Of the $15,190,331 balance unobligated at the end of the year more than half was credited to Alabama, Florida, Mississippi, and North Carolina. Delaware, Louisiana, Maryland, and Utah had completely obligated all funds apportioned to them, and Vermont had virtually no balance. The unobligated funds of other States ranged between these extremes, with balances of less than $100,000 in each of 18 other States.

The amount obligated during the fiscal year was $46,689,025.54. The amount actually paid to the States during the year was $101,266,331.02. By reference to table 11 it will be seen that the amount obligated during the fiscal year 1933 was little more than half of the sum obligated during the preceding year. The amount expended, $101,266,331.02, was exceeded only by the expenditures of the 2 preceding years.

TABLE 11.—*Federal-aid funds apportioned to the States, obligated to projects and paid to the States each fiscal year from 1923 to 1933, inclusive*

Fiscal year	Apportioned amount of appropriation authorized for the year	Amount of Federal-aid funds obligated during the year	Amount of Federal-aid funds paid to States during the year
1923	$48,750,000.00	$77,461,559	$69,677,241.86
1924	63,375,000.00	89,866,864	79,217,397.90
1925	73,125,000.00	87,294,396	95,749,998.11
1926	73,125,000.00	79,608,897	87,754,534.57
1927	73,125,000.00	77,453,046	81,371,013.03
1928	73,125,000.00	88,922,185	80,802,232.55
1929	73,125,000.00	70,428,896	82,097,380.38
1930	73,125,000.00	102,498,084	75,880,862.84
1931	121,875,000.00	157,952,903	133,340,910.64
1932	121,875,000.00	83,793,787	127,367,119.74
1933	[1] 106,034,256.14	46,689,026	101,266,331.02
Total	[2] 900,659,256.14	961,969,643	[2] 1,014,525,022.64
Average	81,878,114.00	87,451,786	92,229,548.00

[1] Apportionment of $121,875,000 less deduction of one fifth of the emergency advance funds paid to the States.

[2] The excess of total payments over total apportionments for these years was possible because from 1917 to 1922, inclusive, the appropriations exceeded the payments by more than an equal amount.

COST OF THE ROADS

The total cost of the 8,503.3 miles of initial construction, the 4,700.5 miles of stage construction, and the 51.5 miles of reconstruction, completed and completely paid for during the year was $234,383,376, of which the Federal Government paid as regular Federal aid $104,673,505.98, and as emergency advances $4,502,467.38. These expenditures, with the exception of the emergency-fund payments, were made over the period required to construct the roads, and additional expenditures were made during the same period for other projects under construction and not yet completed. All the emergency fund expenditure was made after approval of the Emergency Relief and Construction Act of 1932.

As previously stated, the total of Federal-aid funds disbursed during the year on all active projects was $101,266,331.02, as shown in table 27. Of this sum Texas received more than $6,000,000; New York received more than $5,000,000; Illinois, Ohio, and Pennsylvania received more than $4,000,000; and California, Indiana, Michigan, and Missouri received more than $3,000,000. With the exception of seven States—Arkansas, Connecticut, Delaware, Maryland, New Hampshire, Rhode Island, and Vermont—every State received for work done during the year Federal aid in excess of $1,000,000.

FEDERAL-AID STATISTICS

Statistical information relative to the apportionment, obligation, and disbursement of Federal aid during the fiscal year 1933, the cost of roads constructed, the estimated cost of roads under construction, and the types of roads completed and under construction, etc., is given in tables 12 to 27, inclusive.

TABLE 12.—*Mileage of the designated Federal-aid highway system in each State, and mileage improved with Federal aid to June 30, 1933*

State	Mileage of designated Federal-aid highway system	Mileage completed with Federal aid to June 30, 1933	State	Mileage of designated Federal-aid highway system	Mileage completed with Federal aid to June 30, 1933
Alabama	3,933	2,344.3	New Hampshire	988	448.0
Arizona	1,979	1,270.4	New Jersey	1,378	637.9
Arkansas	4,953	1,932.8	New Mexico	3,678	2,300.9
California	5,151	2,500.1	New York	7,936	3,516.6
Colorado	3,659	1,863.7	North Carolina	5,329	2,358.8
Connecticut	978	296.8	North Dakota	7,420	5,432.1
Delaware	744	381.1	Ohio	5,914	3,057.9
Florida	2,478	661.1	Oklahoma	6,089	2,502.2
Georgia	5,610	3,238.8	Oregon	3,800	1,630.5
Idaho	3,219	1,592.4	Pennsylvania	6,971	3,276.8
Illinois	7,394	3,110.9	Rhode Island	484	271.7
Indiana	4,935	2,109.4	South Carolina	3,327	1,962.5
Iowa	7,404	3,540.0	South Dakota	6,279	4,305.3
Kansas	7,919	4,052.9	Tennessee	3,979	1,723.5
Kentucky	3,701	1,933.6	Texas	12,797	8,113.8
Louisiana	2,742	1,619.6	Utah	1,743	1,286.3
Maine	1,588	823.0	Vermont	1,036	393.8
Maryland	2,154	872.7	Virginia	3,782	1,994.3
Massachusetts	1,494	875.9	Washington	3,177	1,330.7
Michigan	5,237	2,339.2	West Virginia	2,223	925.6
Minnesota	6,880	4,309.6	Wisconsin	5,557	2,760.1
Mississippi	3,672	1,863.8	Wyoming	3,565	2,179.8
Missouri	7,789	3,233.2	Hawaii	532	109.4
Montana	5,409	2,973.2			
Nebraska	5,594	4,259.7	Total	206,277	107,868.8
Nevada	1,677	1,352.1			

TABLE 13.—*Total cost, Federal aid, emergency-construction funds and mileage of Federal-aid roads, initial and stage construction and reconstruction completed and paid during the fiscal year 1933*

State	Total cost	Federal aid	Emergency-construction fund	Mileage			
				Initial	Stage	Reconstruction	Total
Alabama	$851,589.81	$416,627.21	$32,096.81	48.3	2.9		51.2
Arizona	2,943,249.17	1,865,813.39	151,038.19	180.2	55.9		236.1
Arkansas	1,217,496.66	547,650.99	11,943.65	42.8	13.1		55.9
California	12,588,064.71	5,053,787.44	100,204.46	259.1	61.7		320.8
Colorado	6,231,801.63	3,245,873.60	39,995.08	261.0	86.1		347.1
Connecticut	890,283.84	385,618.19		15.5			15.5
Delaware	906,164.10	445,822.00		44.7			44.7
Florida	1,631,013.70	655,259.58		46.3			46.3
Georgia	5,607,211.60	2,510,750.75	275,916.35	156.0	196.6		352.6
Idaho	3,156,383.70	1,716,286.11	105,682.63	142.3	272.6		414.9
Illinois	16,893,315.42	7,455,977.97	148,926.69	529.4	18.7		548.1
Indiana	7,427,449.90	3,569,069.33		286.9	20.3		307.2
Iowa	4,057,333.54	1,963,494.89	50,987.40	198.8	57.1		255.9
Kansas	6,640,001.36	3,131,186.23	313,460.23	350.0	504.5		854.5
Kentucky	3,606,398.13	1,549,413.51	166,979.73	198.5	78.8		277.3
Louisiana	3,012,731.39	1,222,892.52		70.6	6.1		76.7
Maine	3,520,877.34	1,596,365.81		113.4			113.4
Maryland	2,269,635.36	980,609.52	26,601.80	90.5	3.9		94.4
Massachusetts	10,932,943.73	3,512,886.73		124.5	.1		124.6
Michigan	13,018,041.46	5,167,271.46	128,676.87	407.0	65.5	19.8	492.3
Minnesota	5,317,756.46	2,050,016.98		104.4	195.3		299.7
Mississippi	1,433,803.60	697,860.59		64.0	23.9		87.9
Missouri	7,604,294.83	3,363,337.14	343,046.76	242.8	98.9		341.7
Montana	4,602,094.59	2,596,366.64	339,139.48	462.7	242.3		705.0
Nebraska	5,990,719.28	2,860,028.67	49,008.26	199.0	190.9		389.9
Nevada	1,551,054.17	1,230,613.97		25.9	152.4	13.7	192.0
New Hampshire	967,954.18	415,666.92	15,537.26	24.7	3.0		27.7
New Jersey	2,526,737.77	1,125,124.36		27.7	.6		28.3
New Mexico	3,020,227.53	1,948,908.43	85,889.00	150.0	74.5		224.5
New York	14,595,175.16	6,178,882.72	161,749.60	348.1	9.9		358.0
North Carolina	1,274,287.01	613,781.87	64,095.20	87.5	9.0		96.5
North Dakota	2,997,722.64	1,424,496.05	250,411.75	451.4	836.3		1,287.7
Ohio	14,118,390.17	4,924,980.24	143,981.17	236.3	69.0	4.6	309.9
Oklahoma	5,748,040.86	2,807,159.37		199.9	63.7	11.2	274.8
Oregon	4,618,655.83	2,482,705.69	15,612.39	163.8	110.2		274.0
Pennsylvania	8,053,881.00	3,338,317.63		214.3			214.3
Rhode Island	899,371.60	402,014.81	82,719.26	18.8		2.2	21.0
South Carolina	2,229,626.74	1,056,781.26		66.4	48.5		114.9
South Dakota	3,510,649.41	1,773,670.77	462,206.74	283.5	362.6		646.1
Tennessee	2,059,702.60	990,386.73	58,621.76	73.3	27.3		100.6
Texas	14,040,148.34	6,385,364.67	133,878.28	728.4	296.8		1,025.2
Utah	865,919.56	532,896.50	18,486.38	61.3	44.5		105.8
Vermont	1,170,553.66	537,596.26	50,266.01	52.5			52.5
Virginia	1,848,006.46	823,207.81	19,626.90	89.9	18.1		108.0
Washington	3,737,632.45	1,647,910.51	155,649.35	122.6	20.1		142.7
West Virginia	2,602,043.78	1,129,053.28		57.6	10.8		68.4
Wisconsin	6,723,170.51	2,669,740.97	365,196.40	215.1	75.0		290.1
Wyoming	2,636,836.36	1,489,510.99	134,835.54	163.5	269.4		432.9
Hawaii	236,932.90	184,466.92		2.1	3.6		5.7
Total	234,383,376.00	104,673,505.98	4,502,467.38	8,503.3	4,700.5	51.5	13,255.3

TABLE 14.—*Total cost, Federal-aid and emergency-construction funds, and mileage of Federal-aid roads, initial and stage construction completed but final payment not made, June 30, 1933* [1]

State	Estimated total cost	Federal aid allotted	Emergency-construction funds allotted	Mileage		
				Initial	Stage	Total
Alabama	$1,022,434.29	$468,949.14	$96,120.09	27.2	9.7	36.9
Arizona	1,054,277.55	613,947.45	414,926.16	32.5	83.6	116.1
Arkansas	802,239.92	395,783.20	62,732.23	16.5	13.3	29.8
California	2,143,562.50	601,583.90	1,175,618.52	23.3	15.5	38.8
Colorado	2,151,461.56	1,073,298.91	459,395.63	93.1	55.5	148.6
Connecticut	101,380.16	41,440.26	59,939.90	5.0		5.0
Delaware	200,108.25	56,668.00	112,872.25	7.0	6.0	13.0
Florida	818,923.98	407,826.68		20.4		20.4
Georgia	1,049,142.26	424,387.40	577,058.27	33.7	25.9	59.6
Idaho	283,965.69	141,776.17	66,545.27	15.0	14.5	29.5
Illinois	407,987.23	192,330.74		21.1		21.1
Indiana	2,117,990.49	1,058,995.21		106.5		106.5
Kansas	911,055.05	366,680.08	383,144.10	96.0	12.6	108.6
Kentucky	1,223,649.20	522,430.82	148,226.34	38.1	43.7	81.8
Louisiana	948,689.27	459,239.53		12.8	1.5	14.3
Maine	178,571.26	79,264.98		4.0		4.0
Maryland	651,470.10	253,713.22	137,104.80	29.0		29.0
Massachusetts	3,769,411.28	1,156,339.54		36.6		36.6
Michigan	1,935,002.26	917,200.00	145,210.00	71.4	26.3	97.7
Minnesota	5,303,803.37	1,720,347.31		106.2	116.9	223.1
Mississippi	1,022,185.17	497,015.24	92,283.94	30.1	18.2	48.3
Missouri	632,031.21	152,433.21	253,965.42	23.9	10.8	34.7
Montana	929,944.41	526,053.72	177,947.77	69.0	19.2	88.2
Nebraska	375,453.00	171,910.99		16.8	7.4	24.2
Nevada	800,236.64	510,730.49	197,203.97	25.9	50.4	76.3
New Hampshire	352,589.90	150,706.90	153,528.30	9.0	2.9	11.9
New Jersey	1,542,436.15	633,999.15		13.1	.3	13.4
New Mexico	1,936,681.20	1,053,864.55	346,467.04	119.4	42.0	161.4
New York	2,519,410.33	842,080.00	150,780.00	40.0	7.7	47.7
North Carolina	517,037.06	258,518.50	258,518.56	76.3	6.8	83.1
North Dakota	1,208,311.82	445,490.29	363,853.37	132.9	148.5	281.4
Ohio	1,061,500.00	352,454.82	162,500.00	29.5	12.5	42.0
Oklahoma	2,767,478.97	1,364,700.23	187,370.55	173.2	22.7	195.9
Oregon	919,789.06	447,573.07	68,359.76	14.4	26.6	41.0
Pennsylvania	3,888,476.78	1,871,028.43	126,500.00	81.9		81.9
South Carolina	309,789.67	147,500.00		1.6	12.0	13.6
South Dakota	502,824.50	168,281.15	251,876.15	16.5	21.4	37.9
Tennessee	893,015.81	445,802.75	334,786.94	11.8	31.7	43.5
Texas	5,583,704.60	2,452,858.80	633,717.23	210.4	145.3	355.7
Utah	1,113,743.01	647,896.53	240,196.21	43.4	88.3	131.7
Vermont	92,612.13	10,089.30	82,522.83	2.2		2.2
Virginia	2,122,902.58	1,026,341.44	332,886.52	104.0	23.8	127.8
Washington	442,269.37	227,700.00	39,346.52	17.2		17.2
West Virginia	664,908.12	282,086.17	50,900.00	19.0	.1	19.1
Wisconsin	856,685.71	264,595.00	179,100.00	17.2	11.1	28.3
Wyoming	473,977.52	111,063.11	310,605.36	46.4	32.2	78.6
Hawaii	1,055,299.79	492,189.85	198,270.76	31.1		31.1
Total	61,660,420.18	26,507,166.23	9,032,380.76	2,171.6	1,166.9	3,338.5

[1] There was no reconstruction in this status.

TABLE 15.—*Total cost, Federal-aid and emergency-construction funds of Federal-aid roads, initial and stage, and reconstruction improvement under construction, by States, June 30, 1933*

State	Estimated total cost	Federal aid allotted	Emergency-construction funds allotted	Mileage			
				Initial	Stage	Reconstruction	Total
Alabama	$5,032,976.50	$2,516,488.13	$2,429,896.53	131.2	110.3		241.5
Arizona	2,884,355.53	1,355,008.46	1,156,973.26	68.0	126.7		194.7
Arkansas	4,613,104.71	2,192,025.82	1,399,024.25	130.6	89.0		219.6
California	7,629,209.24	1,565,804.03	3,164,911.21	130.4	55.1		185.5
Colorado	2,900,175.77	1,320,286.76	1,254,035.41	116.6	19.1		135.7
Connecticut	4,110,880.78	1,695,978.21	713,043.74	43.7	5.3		49.0
Delaware	755,181.00	150,125.44	487,127.75	23.6	15.9		39.5
Florida	6,609,972.32	3,168,669.14	1,622,334.04	172.4			172.4
Georgia	4,303,700.67	1,748,672.41	2,174,794.41	107.4	180.6		288.0
Idaho	2,354,542.60	841,030.70	1,216,551.29	90.6	113.9		204.5
Illinois	20,162,768.27	7,703,139.50	4,817,411.34	617.0	60.6		677.6
Indiana	7,139,311.52	2,773,730.55	1,675,172.53	228.3	20.7		249.0
Iowa	5,321,273.39	803,331.76	3,036,095.00	261.1	38.5		299.6
Kansas	3,498,351.61	1,032,386.15	2,223,231.22	190.3	61.0		251.3
Kentucky	4,024,383.53	1,395,480.17	1,777,631.46	159.6	122.0		281.6
Louisiana	6,392,245.96	2,785,921.90	1,745,559.00	42.3	24.8		67.1
Maine	2,203,423.77	508,213.51	1,022,055.05	66.4	.3		66.7
Maryland	965,442.17	99,880.77	674,480.80	33.3	1.5		34.8
Massachusetts	4,115,901.96	972,218.48	1,716,612.00	57.2	4.9		62.1
Michigan	6,674,228.20	2,567,439.95	3,056,012.55	283.9	97.1		381.0
Minnesota	4,768,398.82	202,728.91	3,368,559.00	150.9	139.9		290.8
Mississippi	6,193,724.28	3,072,313.77	1,887,073.87	185.3	97.9		283.2
Missouri	4,351,270.58	737,807.32	2,924,482.16	173.8	17.0		190.8
Montana	5,616,576.61	3,142,856.07	1,995,179.60	405.9	255.8		661.7
Nebraska	6,234,000.11	2,913,882.72	2,475,211.63	156.3	159.9		316.2
Nevada	1,975,857.64	721,167.78	1,112,891.37	38.7	127.5		166.2
New Hampshire	563,304.16	232,591.90	292,550.93	12.5	.5		13.0
New Jersey	5,309,569.73	1,735,318.97	1,657,733.00	55.7			55.7
New Mexico	2,532,793.19	975,113.25	1,433,387.86	127.9	103.5		231.4
New York	18,271,330.05	5,611,850.00	5,746,708.40	479.1	32.0		511.1
North Carolina	5,040,679.02	2,518,674.96	2,418,532.14	513.8	28.1		541.9
North Dakota	3,495,612.32	1,451,921.71	1,134,146.39	237.3	410.3		647.6
Ohio	8,085,323.09	2,179,738.01	3,881,281.62	177.5	52.3		229.8
Oklahoma	3,951,579.57	1,210,698.90	1,941,473.65	191.3	74.7		266.0
Oregon	4,104,798.63	1,640,267.03	1,893,331.83	106.6	74.4		181.0
Pennsylvania	10,077,698.86	2,532,150.15	5,117,760.00	348.7	14.0		362.7
Rhode Island	1,013,905.12	318,007.01	517,280.74	22.5	.2	4.3	27.0
South Carolina	3,413,612.84	1,277,642.73	1,652,684.92	161.2	154.7		315.9
South Dakota	3,155,035.66	1,288,695.86	1,153,545.62	249.4	201.7		451.1
Tennessee	4,645,392.30	2,321,975.19	2,166,751.30	159.6	29.2	11.6	200.4
Texas	15,549,620.20	5,086,325.25	6,626,962.65	551.2	502.8		1,054.0
Utah	1,877,602.57	774,640.08	981,628.10	127.8	36.3		164.1
Vermont	366,965.01	43,473.80	313,523.12	18.6			18.6
Virginia	4,026,229.27	1,817,348.27	1,651,770.84	179.6	52.7		232.3
Washington	3,045,261.29	916,420.63	1,607,716.37	109.6	9.7		119.3
West Virginia	3,071,207.15	1,256,848.11	1,229,084.72	113.8	8.1		121.9
Wisconsin	5,384,047.69	966,926.70	2,445,526.64	136.3	101.9		238.2
Wyoming	2,606,875.23	859,481.92	1,086,437.37	215.7	137.9		353.6
Hawaii	1,687,095.81	1,138,158.71	401,236.93	36.9			36.9
Total	242,106,796.30	86,140,857.55	98,477,405.61	8,397.4	3,970.3	15.9	12,383.6

TABLE 16.—*Total cost, Federal-aid and emergency-construction funds, and mileage of Federal-aid roads, initial and stage improvement, approved for construction, by States, June 30, 1933* [1]

State	Estimated total cost	Federal aid allotted	Emergency-construction funds allotted	Mileage		
				Initial	Stage	Total
Arizona	$43,050.08	$27,982.56	$15,067.52	-------	5.9	5.9
Arkansas	1,187,545.23	593,772.55	573,258.96	102.1	15.7	117.8
California	73,760.41	17,153.65	35,509.29	.9	2.0	2.9
Colorado	394,215.58	177,396.98	216,818.60	27.9	.2	28.1
Idaho	81,908.25	41,788.31	15,524.69	6.2	3.4	9.6
Illinois	716,775.42	311,902.26	106,925.46	27.0	-------	27.0
Indiana	1,372,003.25	133,528.13	1,130,860.02	65.0	5.3	70.3
Kansas	163,196.62	75,935.47	77,101.92	8.6	3.1	11.7
Kentucky	283,561.74	126,218.05	126,218.06	10.7	13.9	24.6
Maine	38,958.62	3,989.09	15,956.35	-------	1.9	1.9
Maryland	251,758.25	25,648.82	181,382.60	5.4	-------	5.4
Michigan	602,750.00	196,440.00	360,360.00	39.3	.8	40.1
Mississippi	250,653.30	125,326.62	125,326.68	11.6	4.2	15.8
Missouri	445,829.85	91,623.60	227,500.00	13.1	16.6	29.7
Montana	57,325.91	32,350.96	9,963.38	-------	12.0	12.0
New Hampshire	85,798.47	36,415.44	49,383.03	1.6	.7	2.3
New Mexico	111,736.03	44,694.41	61,454.82	-------	5.1	5.1
North Carolina	324,785.47	162,392.71	147,105.10	43.4	.3	43.7
North Dakota	299,625.98	123,677.17	61,302.75	22.8	73.5	96.3
Ohio	76,364.00	23,361.08	48,000.00	1.3	3.3	4.6
Oklahoma	528,539.65	105,707.88	422,831.77	38.2	-------	38.2
Oregon	59,172.74	26,004.62	24,189.48	1.7	1.6	3.3
South Dakota	278,850.45	120,075.71	135,595.30	20.3	29.1	49.4
Texas	719,256.12	250,336.03	244,627.86	40.8	18.3	59.1
Utah	259,868.69	111,261.16	146,207.53	24.7	12.4	37.1
Vermont	201,364.63	43,000.00	153,488.04	7.6	6.5	14.1
Virginia	35,537.10	17,768.54	17,768.55	2.3	-------	2.3
Wisconsin	52,061.50	21,500.00	-------	-------	.9	.9
Total	8,996,253.34	3,067,251.80	4,729,727.76	522.5	236.7	759.2

[1] There was no reconstruction in this status.

TABLE 17.—*Mileage of Federal-aid roads, improved, by types of construction, by States, June 30, 1933*

State	Graded and drained	Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
		Untreated	Treated	Untreated	Treated	Untreated	Treated							
Alabama	212.0	507.3		882.6	4.4		14.7		62.8	135.0	512.8		12.7	2,344.3
Arizona	6.9	31.0		340.1				731.7	.9	38.9	110.6		10.3	1,270.4
Arkansas	91.2			882.1		41.1	86.2			266.0	547.1		19.1	1,932.8
California	403.0			453.3		26.8		427.9	110.1	306.6	755.4		17.0	2,500.1
Colorado	177.8	47.4		790.1		88.6		300.2		14.3	418.8		26.5	1,863.7
Connecticut	2.0			3.3		17.2	5.4		42.7	.6	219.8		5.8	296.8
Delaware	1.7			30.4				11.7		5.5	324.1	6.2	1.5	381.1
Florida	4.4	15.5			1.0	85.4	122.1		72.5	79.1	260.6	10.2	10.3	661.1
Georgia	275.1	783.6		397.1	3.7	52.3	331.9	32.9	225.0	118.0	988.0	3.0	28.2	3,238.8
Idaho	166.8			603.6		158.3		494.9	20.3	92.2	49.8		6.5	1,592.4
Illinois	146.7			.4					3.4	3.2	2,919.0	31.6	6.6	3,110.9
Indiana	5.8			90.2					17.0	12.0	1,970.1	6.6	7.7	2,109.4
Iowa	1,106.2			453.9							1,955.4	22.0	2.5	3,540.0
Kansas	1,141.8	645.1		337.9	115.1			472.6	129.6	10.7	1,012.2	163.2	24.7	4,052.9
Kentucky	513.3			445.9		16.2	50.3	38.1	84.3	207.8	566.7	3.9	7.1	1,933.6
Louisiana	59.9			1,284.4					3.2	41.8	214.4		15.9	1,619.6
Maine				238.3	163.6				230.6		187.0		3.5	823.0
Maryland	4.9			38.9		.1	3.9		270.1	55.5	498.5		.8	872.7
Massachusetts				.4	.4	.2	2.7	18.7	481.2	76.5	285.1		10.7	875.9
Michigan	92.6			351.3			16.3		5.4	96.4	1,770.4	.4	6.4	2,339.2
Minnesota	1,061.4	11.1		1,486.7	17.7					32.7	1,697.0		3.0	4,309.6
Mississippi	328.9	15.8		1,141.7		11.1				12.5	329.0	9.5	15.3	1,863.8
Missouri	402.4			764.0		19.6			27.4	7.2	1,989.4	7.5	15.7	3,233.2
Montana	266.3			2,176.3				467.6		13.1	37.4		12.5	2,973.2
Nebraska	365.6	3,261.5	6.6					103.4		14.6	477.4	19.4	11.2	4,259.7
Nevada	31.8			432.0	10.2			829.2	5.8	24.8	16.5		1.8	1,352.1
New Hampshire					.3	91.6	87.4		90.4	31.9	141.1		5.3	448.0
New Jersey	11.6			6.1			.2		.7	22.5	592.2		4.6	637.9
New Mexico	246.7	19.1		1,578.5				353.4		.7	91.7		10.8	2,300.9
New York	63.1			90.0					461.2	115.4	2,784.0	.7	2.2	3,516.6
North Carolina	81.0	461.9	44.1	126.9	46.2	32.8	8.9	140.7	35.3	302.5	1,070.2		8.3	2,358.8
North Dakota	630.3	.3		4,513.9	129.1			121.7		1.2	26.1		9.5	5,432.1
Ohio	126.8			51.1		107.7	26.1		373.3	140.3	1,528.4	679.1	25.1	3,057.9
Oklahoma	605.3	.6		519.1	8.3	28.8			.6	151.0	1,161.1	8.9	18.5	2,502.2
Oregon	311.5			773.9	30.4	42.9	50.9	16.3	245.0	43.7	106.1		9.8	1,630.5
Pennsylvania	171.0					476.6	10.6		7.8	93.9	2,466.7	43.4	6.8	3,276.8
Rhode Island	5.8						1.8		94.4	45.9	120.7		3.1	271.7
South Carolina	52.8	876.4		101.0					.3	185.0	722.8		24.2	1,962.5
South Dakota	147.1	20.2	15.7	3,790.9	46.1			113.9		4.9	159.3		7.2	4,305.3
Tennessee	165.5			106.2		61.5			341.8	232.7	805.3		10.5	1,723.5
Texas	940.0	15.2		2,554.0	505.9	69.0	260.7	10.7	519.9	821.5	2,329.4	30.2	57.3	8,113.8

Utah	94.0			350.3	7.4	260.1		431.6	.8	14.4	123.3		4.4	1,286.3
Vermont				117.6	2.0	1.1		16.1	61.2		188.5		7.3	393.8
Virginia	184.0	372.6	13.7	108.9	5.2	317.9	41.5		386.8	48.5	503.3		11.9	1,994.3
Washington	239.9			600.8							483.0		7.0	1,330.7
West Virginia	258.9			30.5		19.5	1.7	1.4	200.1	28.1	371.6	10.3	3.5	925.6
Wisconsin	172.7	19.0		866.6	15.8				13.8	.5	1,660.7		11.0	2,760.1
Wyoming	400.1	7.1		1,205.8				515.3	1.7	22.1	17.4		10.3	2,179.8
Hawaii									75.8	13.3	19.0		1.3	109.4
Total	11,776.6	7,110.7	80.1	31,117.0	1,112.8	2,026.4	1,123.3	5,650.0	4,703.2	3,985.0	37,584.4	1,056.1	543.2	107,868.8

TABLE 18.—*Mileage of Federal-aid roads, by types of construction, by States, initially completed and paid for during fiscal year 1933*

State	Graded and drained	Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
		Untreated	Treated	Untreated	Treated	Untreated	Treated							
Alabama	47.9												0.4	48.3
Arizona	5.3			75.2				97.8					1.9	180.2
Arkansas	22.5			4.2							15.8		.3	42.8
California	21.5			21.6				98.8		42.9	70.6		3.7	259.1
Colorado	.4			174.7				69.5			14.1		2.3	261.0
Connecticut	2.0						5.3				7.6		.6	15.5
Delaware				10.2							33.9		.6	44.7
Florida							2.9			4.1	39.1		.2	46.3
Georgia	67.1	6.4		22.1			10.6	.9			48.4		.5	156.0
Idaho				54.8				87.2					.3	142.3
Illinois	43.6										481.1		4.7	529.4
Indiana	18.5										266.3		2.1	286.9
Iowa	60.9			26.0							111.6		.3	198.8
Kansas	191.2	.9		28.0				80.8			46.2		2.9	350.0
Kentucky	120.5			25.9		1.0					50.4		.7	198.5
Louisiana	19.9			1.2							48.8		.7	70.6
Maine				3.2	47.3				39.1		22.6		1.2	113.4
Maryland									29.1	16.1	45.2		.1	90.5
Massachusetts									63.8	7.4	48.4		4.9	124.5
Michigan	125.5			29.9						12.1	238.5		1.0	407.0
Minnesota	43.2										61.2			104.4
Mississippi	41.1										22.4		.5	64.0
Missouri	17.8			48.0							175.8		1.2	242.8
Montana	187.2			214.7				59.3					1.5	462.7
Nebraska	7.0	132.3						26.5			31.3	.1	1.8	199.0
Nevada				25.9										25.9
New Hampshire							2.9		3.6		17.7		.5	24.7
New Jersey									.1		27.0		.6	27.7
New Mexico	11.1			116.2				14.9			5.4		2.4	150.0
New York	17.5			15.3					24.2	34.5	256.5		.1	348.1
North Carolina		16.8	22.6	20.7	6.7			10.1		2.2	7.8		.6	87.5
North Dakota	346.5			103.3				1.1					.5	451.4
Ohio	6.1			14.9					10.8	13.8	131.4	48.0	11.3	236.3
Oklahoma	61.1										137.8		1.0	199.9
Oregon	17.6			23.5	7.2	7.3	38.8	4.9	62.4	.9			1.2	163.8
Pennsylvania	.9					132.3					78.7	1.1	1.3	214.3
Rhode Island	5.8								3.8	1.3	7.4		.5	18.8
South Carolina											66.3		.1	66.4
South Dakota	45.1			235.8							2.3		.3	283.5
Tennessee	12.4									26.3	34.1		.5	73.3
Texas	496.6			6.8	49.9		11.0		8.1	.1	147.5		8.4	728.4

Utah				51.2				8.7		.6	.6	.2	61.3
Vermont				7.4				16.1	3.1		25.5	.4	52.5
Virginia	10.2	46.1				23.1			7.3		2.8	.4	89.9
Washington	22.6			60.8							38.6	.6	122.6
West Virginia	18.0										38.9	.7	57.6
Wisconsin	44.9			17.2							152.4	.6	215.1
Wyoming	41.5			79.6				41.4				1.0	163.5
Hawaii									1.5			.6	2.1
Total	2,201.0	202.5	22.6	1,518.3	111.1	163.7	71.5	618.0	256.9	162.3	3,058.0	49.2	68.2	8,503.3

TABLE 19.—*Mileage of Federal-aid roads, by types of construction, by States, initial construction completed but final payment not made, June 30, 1933*

State	Graded and drained	Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
		Untreated	Treated	Untreated	Treated	Untreated	Treated							
Alabama	26.0										0.8		0.4	27.2
Arizona				25.8				5.0			1.7			32.5
Arkansas	6.1										10.1		.3	16.5
California	11.3			1.6				3.6			3.0		3.8	23.3
Colorado				64.9				25.2					3.0	93.1
Connecticut				3.1							1.9			5.0
Delaware	1.7									0.2	5.1			7.0
Florida							9.6				9.7		1.1	20.4
Georgia	10.2						6.2				17.3			33.7
Idaho				12.3				2.5					.2	15.0
Illinois	13.4										7.2		.5	21.1
Indiana											106.5			106.5
Iowa														
Kansas	86.3	8.0									.9		.8	96.0
Kentucky	13.8										24.1		.2	38.1
Louisiana											12.2		.6	12.8
Maine									3.9				.1	4.0
Maryland									21.1		7.8		.1	29.0
Massachusetts									10.3		25.4		.9	36.6
Michigan	17.3			10.5						1.5	41.9		.2	71.4
Minnesota	45.5										60.7			106.2
Mississippi	21.5										7.6		1.0	30.1
Missouri	3.7			17.4							2.7		.1	23.9
Montana	23.0			45.7									.3	69.0
Nebraska		16.8												16.8
Nevada				1.1				24.8						25.9
New Hampshire											9.0			9.0
New Jersey											12.8		.3	13.1
New Mexico				67.9				50.8					.7	119.4
New York	9.1									.1	30.7		.1	40.0
North Carolina		8.8	17.5		19.1	7.0	9.0			14.3	.2		.4	76.3
North Dakota	96.2			36.5									.2	132.9
Ohio										6.6	18.8	3.8	.3	29.5
Oklahoma	130.2										41.6		1.4	173.2
Oregon	3.3			2.6			8.1				.3		.1	14.4
Pennsylvania	2.4					40.6				.5	37.4		1.0	81.9
Rhode Island														
South Carolina											1.6			1.6
South Dakota				16.4									.1	16.5
Tennessee	7.2										4.6			11.8

Texas	109.7			8.1	33.6		32.3			.2	23.5		3.0	210.4
Utah				22.1				14.0			6.9		.4	43.4
Vermont				2.1									.1	2.2
Virginia	32.4	27.3				40.9					2.8		.6	104.0
Washington				17.1									.1	17.2
West Virginia											19.0			19.0
Wisconsin				6.8							10.2		.2	17.2
Wyoming	19.6			26.5									.3	46.4
Hawaii									31.0				.1	31.1
Total	689.9	60.9	17.5	388.5	52.7	88.5	65.2	125.9	66.3	23.4	566.0	3.8	23.0	2,171.6

TABLE 20.—*Mileage of Federal-aid roads, by types of construction, by States, under initial construction, June 30, 1933*

State	Graded and drained	Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
		Untreated	Treated	Untreated	Treated	Untreated	Treated							
Alabama	45.2							14.2		14.5	55.8		1.5	131.2
Arizona	22.2			24.9				20.3					.6	68.0
Arkansas	3.0			3.7	19.4			27.8			75.9		.8	130.6
California	17.9				6.3			50.8		21.5	32.3		1.6	130.4
Colorado	6.8			76.8				13.9		13.4	2.7		3.0	116.6
Connecticut				5.5					6.9	.2	27.1		4.0	43.7
Delaware											23.6			23.6
Florida	85.0						34.3			5.2	42.2		5.7	172.4
Georgia	55.7		0.2		11.7		22.0	.3		6.0	10.6		.9	107.4
Idaho				80.0				10.2					.4	90.6
Illinois	30.2										580.7		6.1	617.0
Indiana	27.3										196.4		4.6	228.3
Iowa	69.5			56.2							134.2		1.2	261.1
Kansas	172.2			7.0							9.2		1.9	190.3
Kentucky	116.6			10.5							31.0		1.5	159.6
Louisiana	8.4			2.1							28.9		2.9	42.3
Maine					27.8				8.3		29.5		.8	66.4
Maryland	4.3			6.1					6.9	4.6	11.2		.2	33.3
Massachusetts								3.5	22.1	11.4	18.5		1.7	57.2
Michigan	84.3			53.0				5.8		13.3	126.6		.9	283.9
Minnesota	108.5										42.4			150.9
Mississippi	88.8		9.3	4.2						8.7	71.7		2.6	185.3
Missouri	26.6			75.1							70.3		1.8	173.8
Montana	112.1			259.6				32.4					1.8	405.9
Nebraska	75.6	26.7						39.5			12.0		2.5	156.3
Nevada	8.0			19.3				10.3			1.1			38.7
New Hampshire					1.5		6.6		1.3		2.7		.4	12.5
New Jersey	12.7								.2		41.5		1.3	55.7
New Mexico	43.7			75.9	6.8						.2		1.3	127.9
New York	52.2			68.6	6.2				34.7	37.0	277.7	1.1	1.6	479.1
North Carolina	72.4	127.1	51.7	100.9	55.1	31.5		73.1					2.0	513.8
North Dakota	218.7			17.6				.4					.6	237.3
Ohio	9.0			1.0			1.2			38.6	88.6	35.6	3.5	177.5
Oklahoma	162.0										27.5		1.8	191.3
Oregon	51.6			18.1					28.1	.1	7.3		1.4	106.6
Pennsylvania	24.1					142.1	14.5			39.6	127.1		1.3	348.7
Rhode Island									11.9	3.4	7.1		.1	22.5
South Carolina		18.0	85.4		20.2						37.1		.5	161.2
South Dakota	135.5			112.7				.9					.3	249.4
Tennessee	63.3									37.8	55.5		3.0	159.6
Texas	277.4			48.0	72.6		12.2		6.0	5.8	121.7	3.1	4.4	551.2

Utah				94.8				28.3		1.5	2.4		.8	127.8
Vermont				18.3				.1			.1		.1	18.6
Virginia	32.3	79.9		1.0		59.4				.3	6.1		.6	179.6
Washington	17.1			91.7									.8	109.6
West Virginia	82.7			3.1			21.0				6.6		.4	113.8
Wisconsin	36.6			11.7							87.1		.9	136.3
Wyoming	157.1			17.7				40.0					.9	215.7
Hawaii									36.6				.3	36.9
Total	2,616.6	251.7	146.6	1,365.1	227.6	233.0	111.8	371.8	163.0	262.9	2,530.2	39.8	77.3	8,397.4

TABLE 21.—*Mileage of Federal-aid roads, by types of construction, by States, approved for initial construction, on June 30, 1933*

State	Graded and drained	Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
		Untreated	Treated	Untreated	Treated	Untreated	Treated							
Arkansas	12.7				11.1		15.0	63.2					0.1	102.1
California											0.9			.9
Colorado				27.9										27.9
Idaho				6.2										6.2
Illinois											26.9		.1	27.0
Indiana	17.3										47.7			65.0
Kansas	1.8	3.0		1.2							2.5		.1	8.6
Kentucky	6.7										4.0			10.7
Maryland											5.3		.1	5.4
Michigan	4.0	6.5		3.7						10.7	13.9	0.5		39.3
Mississippi	11.1										.2		.3	11.6
Missouri											13.1			13.1
New Hampshire							1.6							1.6
North Carolina		13.3			.2	17.4		12.0			.5			43.4
North Dakota	22.6			.2										22.8
Ohio										1.1	.2			1.3
Oklahoma	34.7										3.0		.5	38.2
Oregon										1.4	.3			1.7
South Dakota	20.3													20.3
Texas	21.3			18.9									.6	40.8
Utah				17.1				5.0		1.9	.7			24.7
Vermont								7.4					.2	7.6
Virginia	2.3													2.3
Total	154.8	22.8		75.2	11.3	17.4	16.6	87.6		15.1	119.2	.5	2.0	522.5

TABLE 22.—*Mileage of Federal-aid road stage construction, by types of construction, by States, completed and paid for during fiscal year 1933*

State	Graded and drained	Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
		Untreated	Treated	Untreated	Treated	Untreated	Treated							
Alabama											2.9			2.9
Arizona	0.5			19.4				32.5		3.1			0.4	55.9
Arkansas				1.3							11.7		.1	13.1
California				.4				20.4		4.1	35.1		1.7	61.7
Colorado				.3				50.1			35.3		.4	86.1
Georgia	38.1			12.2			46.3				99.3		.7	196.6
Idaho				8.8				260.3		3.3			.2	272.6
Illinois											18.7			18.7
Indiana											19.3		1.0	20.3
Iowa	.9										56.2			57.1
Kansas	3.1	127.9		18.5				323.1		7.7	23.2		1.0	504.5
Kentucky				22.4						5.4	50.9		.1	78.8
Louisiana											6.1			6.1
Maryland										2.3	1.6			3.9
Massachusetts													.1	.1
Michigan	7.3									8.0	49.8		.4	65.5
Minnesota	44.9										150.3		.1	195.3
Mississippi	15.1										8.4		.4	23.9
Missouri				3.5							95.3		.1	98.9
Montana				110.3				132.0						242.3
Nebraska		14.8						51.6			123.6		.9	190.9
Nevada				.8				151.2					.4	152.4
New Hampshire											3.0			3.0
New Jersey													.6	.6
New Mexico				9.8				63.8					.9	74.5
New York										6.9	3.0			9.9
North Carolina			4.0					5.0						9.0
North Dakota	26.4			740.5				69.1		.1			.2	836.3
Ohio				.2					0.9	.4	44.6	21.2	1.7	69.0
Oklahoma											63.7			63.7
Oregon				49.3			3.4		48.1	6.2	3.2			110.2
South Carolina	14.9										33.6			48.5
South Dakota	70.2			145.2	38.5			62.6		4.9	40.8		.4	362.6
Tennessee										6.4	20.9			27.3
Texas	15.9			2.8	54.2		40.5			9.2	173.1		1.1	296.8
Utah				2.1				41.7			.5		.2	44.5
Virginia		7.9				5.1	4.0				1.1			18.1
Washington	.1			1.6							18.4			20.1
West Virginia	6.1										4.7			10.8
Wisconsin	2.1										72.6		.3	75.0
Wyoming	2.3			172.9				93.8					.4	269.4
Hawaii									3.6					3.6
Total	247.9	150.6	4.0	1,322.3	92.7	5.1	94.2	1,357.2	52.6	68.0	1,270.9	21.2	13.8	4,700.5

TABLE 23.—*Mileage of Federal-aid roads, by types of construction, by States, stage construction, completed but final payment not made, June 30, 1933*

State	Graded and drained	Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
		Untreated	Treated	Untreated	Treated	Untreated	Treated							
Alabama											9.7			9.7
Arizona								82.8					0.8	83.6
Arkansas											13.3			13.3
California											15.2		.3	15.5
Colorado	0.7			3.4				40.3			10.8		.3	55.5
Delaware											6.0			6.0
Georgia							16.4				9.4		.1	25.9
Idaho				7.7				6.5					.3	14.5
Kansas	9.5										3.0		.1	12.6
Kentucky				20.3				12.4			11.0			43.7
Louisiana											1.5			1.5
Michigan										7.4	18.9			26.3
Minnesota											116.8		.1	116.9
Mississippi	8.9										9.3			18.2
Missouri											10.7		.1	10.8
Montana				9.1				10.1						19.2
Nebraska											7.4			7.4
Nevada				23.5				26.8					.1	50.4
New Hampshire											2.9			2.9
New Jersey													.3	.3
New Mexico								39.7			2.1		.2	42.0
New York											7.7			7.7
North Carolina					6.7						.1			6.8
North Dakota				140.5							8.0			148.5
Ohio									0.4	1.9	10.1		.1	12.5
Oklahoma											22.6		.1	22.7
Oregon	1.9			.7			.6		16.5	6.1	.4		.4	26.6
South Carolina											11.9		.1	12.0
South Dakota	8.0			1.0							12.4			21.4
Tennessee	1.1									14.4	16.1		.1	31.7
Texas	3.6			1.5	24.5		10.7			11.8	92.7		.5	145.3
Utah				5.5				81.3			1.1		.4	88.3
Virginia		7.4		2.0						7.6	6.5		.3	23.8
West Virginia													.1	.1
Wisconsin											11.1			11.1
Wyoming	.8			19.2				12.2						32.2
Total	34.5	7.4		234.4	31.2		27.7	312.1	16.9	49.2	448.7		4.8	1,166.9

TABLE 24.—*Mileage of Federal-aid roads, by types of construction, by States, under stage construction, on June 30, 1933*

State	Graded and drained	Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
		Untreated	Treated	Untreated	Treated	Untreated	Treated							
Alabama	0.4						1.6	22.8		14.5	70.8		0.2	110.3
Arizona				5.7				120.2					.8	126.7
Arkansas	15.6			2.5	8.9			10.7			50.2		1.1	89.0
California	5.9				2.7			10.8		16.4	19.1		.2	55.1
Colorado				11.0				7.7			.1		.3	19.1
Connecticut											5.3			5.3
Delaware	7.8										8.1			15.9
Georgia	16.5		18.5		23.2		55.8	5.2		10.0	50.7		.7	180.6
Idaho				9.0				104.8					.1	113.9
Illinois	3.6										55.8		1.2	60.6
Indiana											20.7			20.7
Iowa											38.5			38.5
Kansas	6.0							39.1	0.3	4.3	11.0		.3	61.0
Kentucky				38.9						26.6	56.4		.1	122.0
Louisiana	2.0										22.3		.5	24.8
Maine											.3			.3
Maryland										1.5				1.5
Massachusetts									2.1		2.8			4.9
Michigan	1.0			5.4							90.6		.1	97.1
Minnesota	40.3			6.6							93.0			139.9
Mississippi	20.3			.2						19.4	57.0		1.0	97.9
Missouri											16.9		.1	17.0
Montana	3.5			134.4				117.6					.3	255.8
Nebraska	41.3	2.6						18.7			94.0		3.3	159.9
Nevada	12.6			23.5				81.5		5.4	3.9		.6	127.5
New Hampshire									.4				.1	.5
New Mexico	8.0			13.0	15.0			65.6					1.9	103.5
New York										2.9	29.0		.1	32.0
North Carolina			16.9		7.3			3.4			.3		.2	28.1
North Dakota	19.5			192.7	10.8			185.6		1.4			.3	410.3
Ohio										32.2	19.2	0.1	.8	52.3
Oklahoma	6.9										67.7		.1	74.7
Oregon	23.5			18.5			5.0		11.7	.6	14.8		.3	74.4
Pennsylvania											14.0			14.0
Rhode Island											.2			.2
South Carolina			122.8		18.3						13.5		.1	154.7
South Dakota	42.2			31.7				117.7			10.1			201.7
Tennessee											29.2			29.2
Texas	85.5			61.9	91.7		41.5			28.8	190.9		2.5	502.8
Utah				20.9				13.3		2.1				36.3
Virginia		1.3		4.2		15.1				4.4	27.6		.1	52.7
Washington	.2			8.9							.5		.1	9.7
West Virginia							3.7				4.4			8.1
Wisconsin	7.8			4.7							89.1		.3	101.9
Wyoming	20.5			51.9				65.3					.2	137.9
Total	390.9	3.9	158.2	645.6	177.9	15.1	107.6	990.0	14.5	170.5	1,278.0	.1	18.0	3,970.3

TABLE 25.—*Mileage of Federal-aid roads, by types of construction, by States, approved for stage construction, June 30, 1933*

State	Graded and drained	Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
		Untreated	Treated	Untreated	Treated	Untreated	Treated							
Arizona								5.8					0.1	5.9
Arkansas					1.4			14.3						15.7
California								2.0						2.0
Colorado				0.2										.2
Idaho								3.4						3.4
Indiana											5.3			5.3
Kansas								3.1						3.1
Kentucky				6.5							7.4			13.9
Maine									1.9					1.9
Michigan											.8			.8
Mississippi	4.1												.1	4.2
Missouri											16.6			16.6
Montana				7.8				4.2						12.0
New Hampshire											.7			.7
New Mexico											5.1			5.1
North Carolina					.3									.3
North Dakota				73.5										73.5
Ohio										2.5	.8			3.3
Oregon								1.3			.3			1.6
South Dakota				.3				28.8						29.1
Texas	17.9			.3									.1	18.3
Utah								11.5			.9			12.4
Vermont								6.5						6.5
Wisconsin											.7		.2	.9
Total	22.0			88.6	1.7			80.9	1.9	2.5	38.6		.5	236.7

TABLE 26.—*Net changes of mileage in the types of Federal-aid improvement on the Federal-aid highway system during the fiscal year 1933*

State	Graded and drained	Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
		Untreated	Treated	Untreated	Treated	Untreated	Treated							
Alabama	−29.9	−11.4		−18.5							10.0		0.2	−49.6
Arizona	−20.6	−9.7		−70.6				151.2		0.8	−.8			50.3
Arkansas	−1.5			−21.3							−4.8		.2	−27.4
California	−.5			−17.3		−5.0		70.4	−2.6	33.6	93.5		−.6	171.5
Colorado	−7.9			82.6		−2.7		162.2			22.4		3.9	260.5
Connecticut	2.0			3.1			5.3				4.3		.4	15.1
Delaware	1.2			10.2						.2	23.2		.6	35.4
Florida							12.6			.4	9.6		.5	23.1
Georgia	38.6	−89.9		12.1			79.5	.9	−1.9		130.0		1.1	170.4
Idaho	−31.2			−134.6		−45.4		343.3		−.9			.9	132.1
Illinois	27.2								.1	−4.9	439.3			461.7
Indiana	−9.7										295.3		1.8	287.4
Iowa	57.9			−34.9							166.4		.4	189.8
Kansas	−69.2	61.1		−48.3	−0.5	−.2		403.9	−.3	7.8	52.6	−1.2	4.2	409.9
Kentucky	−70.4			−30.3		−4.3		12.4		5.3	109.4		.5	22.6
Louisiana	−18.6			1.6							68.4		1.4	52.8
Maine				3.3	36.1				39.6		22.4		1.2	102.6
Maryland									32.4	18.4	42.9		.1	93.8
Massachusetts								−.3	31.1	−.2	25.3		2.7	58.6
Michigan	17.3			−4.2						9.8	243.5		1.3	267.7
Minnesota	52.6			−88.6							389.2		.3	353.5
Mississippi	48.1			−27.5							32.4		1.8	54.8
Missouri	3.7			64.7						−12.8	254.3		1.3	311.2
Montana	−44.2			163.1				128.4		.1			1.5	248.9
Nebraska	14.5	−132.3						75.0			48.1		−.8	4.5
Nevada	−4.8			−75.2				171.2	−14.7	13.7	−19.4		.1	70.9
New Hampshire						−.6			3.6	−.6	24.5		.1	27.0
New Jersey				.1							20.1		1.2	21.4
New Mexico	6.1			−79.9				119.4			4.6		.6	50.8
New York	−5.2			10.1					15.0	25.4	197.7		.2	243.2
North Carolina	−.1	4.6	44.1	10.6	25.3	7.0	8.9	15.1	−.3	14.4	2.1		.7	132.4
North Dakota	−368.0			668.7				60.2		.1	8.0		.4	369.4
Ohio	3.2			10.0		−.2			−.6	−8.0	151.2	36.0	7.9	199.5
Oklahoma	91.6			−13.6							127.2		1.8	207.0
Oregon	−34.9			21.7	2.3	−2.2	23.1	4.8	111.8	−17.3	−3.4		1.8	107.7
Pennsylvania	2.6					165.4				−5.3	100.1	.1	1.3	264.2
Rhode Island	5.8								3.6	−3.0	9.2		.5	16.1
South Carolina		−137.0									85.7		.2	−51.1
South Dakota	42.8			79.4	38.5			62.7		4.9	36.9		.7	265.9
Tennessee	−56.6								−11.6	42.7	66.0		.6	41.1
Texas	−68.7	−11.0		−123.0	148.3	−14.4	73.5	−9.1	−8.9	10.7	303.5		10.2	311.1

TABLE 26.—*Net changes of mileage in the types of Federal-aid improvement on the Federal-aid highway system during the fiscal year 1933*—Continued

State	Graded and crained	Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
		Untreated	Treated	Untreated	Treated	Untreated	Treated							
Utah	−14.0			30.3		−88.3		145.7		.5	8.0		.6	82.8
Vermont				9.5				16.1	3.1		25.5		.5	54.7
Virginia	25.6	34.1		−2.2		33.8	4.0		−1.1	7.6	−30.9		.5	71.4
Washington	18.4			57.0							56.7		.7	132.8
West Virginia	4.8			−3.8					.6		30.4	−.3	.6	32.3
Wisconsin	6.3	−.6		−72.3							232.2		.7	166.3
Wyoming	−56.5	7.0		199.1				134.3					1.6	285.5
Hawaii	−3.6								36.1				.6	33.1
Total	−445.8	−285.1	44.1	571.1	250.0	42.9	206.9	2,067.8	235.0	143.4	3,912.8	34.6	59.0	6,836.7

TABLE 27.—*Federal-aid apportionment, and the amounts paid to the States for the fiscal year 1933, and the unobligated balance of the total apportionment on June 30, 1933*

State	Apportionment fiscal year 1933	Paid to States during the fiscal year 1933	Unobligated balances of total apportionment on June 30, 1933
Alabama	$2,251,487.72	$1,577,192.89	$3,199,828.75
Arizona	1,556,080.80	1,521,733.57	1,610.68
Arkansas	1,846,477.60	929,977.49	663,644.66
California	4,140,910.53	3,698,351.31	117,095.88
Colorado	1,988,953.60	2,185,645.98	269,439.58
Connecticut	687,401.80	370,196.56	183,167.11
Delaware	529,375.00	401,968.10	
Florida	1,437,372.40	1,309,949.87	989,164.32
Georgia	2,753,344.80	2,716,911.99	100,636.93
Idaho	1,330,448.00	1,315,840.41	73,920.51
Illinois	4,476,553.80	4,696,333.40	95,967.25
Indiana	2,698,897.20	3,150,523.32	209,145.99
Iowa	2,799,805.20	2,535,126.77	59,251.82
Kansas	2,889,065.80	2,435,972.62	153,217.33
Kentucky	1,994,012.00	1,517,615.33	48,791.33
Louisiana	1,569,830.67	1,744,791.99	
Maine	944,168.20	1,364,815.44	76,304.51
Maryland	895,409.60	792,361.75	
Massachusetts	1,511,244.00	2,481,476.40	351,632.06
Michigan	3,338,014.60	3,758,635.13	175,723.01
Minnesota	2,976,273.40	2,946,417.36	34,304.16
Mississippi	1,907,440.80	1,119,779.63	2,952,041.86
Missouri	3,346,264.88	3,020,058.58	8,827.28
Montana	2,230,177.00	2,957,527.27	401,817.97
Nebraska	2,256,040.80	2,908,956.42	49,318.84
Nevada	1,421,688.63	1,382,302.60	117,662.21
New Hampshire	529,375.00	419,190.18	64,377.21
New Jersey	1,463,483.60	1,151,062.66	109,558.29
New Mexico	1,732,343.40	1,245,058.57	85,464.22
New York	5,342,506.80	5,297,698.28	355,781.37
North Carolina	2,550,007.00	1,830,951.42	977,044.05
North Dakota	1,710,936.60	1,463,221.78	416,198.04
Ohio	3,971,690.40	4,869,738.14	190,835.32
Oklahoma	2,553,034.80	1,703,492.27	433,937.87
Oregon	1,767,475.80	1,855,778.01	56,880.55
Pennsylvania	4,640,667.40	4,150,584.63	53,641.77
Rhode Island	529,375.00	414,113.90	70,834.03
South Carolina	1,469,603.80	1,088,720.55	12,443.92
South Dakota	1,765,764.40	1,411,030.29	169,101.27
Tennessee	2,302,158.60	2,420,799.23	576,790.79
Texas	6,811,084.83	6,330,692.65	49,990.22
Utah	1,223,723.28	1,181,546.86	
Vermont	529,375.00	505,130.44	151.97
Virginia	1,992,380.60	1,538,556.73	194,541.87
Washington	1,681,216.40	1,698,496.48	59,732.72
West Virginia	1,162,217.20	1,177,605.05	49,516.08
Wisconsin	2,640,713.00	2,614,088.36	265,183.36
Wyoming	1,359,009.40	1,043,959.29	151,122.56
Hawaii	529,375.00	1,014,353.07	514,689.68
Total	106,034,256.14	101,266,331.02	15,190,331.20

NATIONAL-FOREST-ROAD CONSTRUCTION

The appropriations made for improvement of roads in the national forests recognize and provide separately for two principal classes of road, designated, respectively, as forest highways and forest-development roads. Forest-development roads, as the name implies, are roads which serve primarily for the development of the forests and which are needed for the protection and administration of the forests. In the main they are lightly traveled and entail no large expense for their improvement. Forest highways are roads of a higher order of traffic importance, generally those joining sections of the Federal-aid or State highway systems outside the forests or important community-service roads, and requiring, in consequence, types of improvement that are generally more expensive than those required for the forest development roads.

For both classes of roads the act of May 5, 1930, authorized an appropriation of $12,500,000 to be available in the fiscal year 1933 and thereafter until expended. In accordance with the provisions of the Federal Highway Act $3,000,000 of this sum was set apart for forest-development roads, and the remainder, $9,500,000, was available for forest-highway construction.

For the construction of forest highways there was subsequently appropriated by the Emergency Relief and Construction Act of 1932 an additional sum of $5,000,000 to be available for expenditure during the fiscal year 1933 only; but

the period of availability was later extended through the fiscal year 1934 by act approved March 3, 1933.

In the main, the work supervised by the Bureau of Public Roads is limited to the construction of forest highways, for which the combined sums authorized and appropriated for the fiscal year 1933 were $14,500,000, as above noted. Forest-development road work generally is administered by the Forest Service. While this definition of the work of the two bureaus is approximately correct, the exact line of separation is drawn between what are termed major and minor projects. Projects of the major class which, under the rules and regulations, are administered by the Bureau of Public Roads, include all projects on the forest-highway system, except those which do not require the technical services of a highway-engineering organization and those having an estimated average cost of less than $2,000 per mile, and in addition, those forest-development road projects of estimated average cost in excess of $5,000 per mile and those requiring the technical services of a highway-engineering organization.

In accordance with requirements of the governing rules and regulations a system of forest highways has been designated by concurrent action of the several State highway departments, the Forest Service, and this Bureau, approved by the Secretary of Agriculture. Also as required by the rules and regulations the highways constituting this system have been classified as follows:

Class 1. Forest roads forming sections of the Federal-aid highway system, either wholly within or, when so designated by the Forester and the Chief of the Bureau of Public Roads, partly without and adjacent to the national forests.

Class 2. Forest roads, not of class 1, which are parts of approved State highway systems, when so designated by the Forester and the Chief of the Bureau of Public Roads.

Class 3. All other forest roads, of primary importance to counties or communities.

The roads which, according to these definitions, had been classified as forest highways, had an aggregate length on June 30, 1933, of 16,458.3 miles, classified as shown in table 28.

TABLE 28.—*Classification of the mileage of the forest-highway system as revised to June 30, 1933*

State	Mileage of forest-highway system			
	Class 1	Class 2	Class 3	Total
Western:				
Alaska			459.9	459.9
Arizona	320.6	245.0	495.9	1,061.5
California	578.4	785.8	962.8	2,327.0
Colorado	508.0	1,113.0	104.0	1,725.0
Idaho	687.2	144.0	212.7	1,043.9
Montana	628.3	335.8	238.0	1,202.1
Nevada	104.0	190.6	166.8	461.4
New Mexico	164.0	517.0		681.0
Oregon	524.7	411.7	435.1	1,371.5
South Dakota	227.0		86.0	313.0
Utah	58.6	539.3	139.2	737.1
Washington	386.5	135.4	247.9	769.8
Wyoming	387.3	37.0	217.7	642.0
Total	4,574.6	4,454.6	3,766.0	12,795.2
Eastern:				
Alabama	4.0		31.0	35.0
Arkansas	192.3	144.3	90.5	427.1
Florida	39.7	81.0	36.3	157.0
Georgia	41.8	37.5	68.7	148.0
Louisiana	36.3	105.7	12.0	154.0
Maine			11.0	11.0
Michigan	49.9	108.5	150.3	308.7
Minnesota	89.5		222.2	311.7
Mississippi	32.0	13.0	51.0	96.0
Nebraska			28.8	28.8
New Hampshire	41.5	60.5	49.0	151.0
North Carolina	102.0	105.3	48.3	255.6
Oklahoma	31.5		70.5	102.0
Pennsylvania	134.0	248.0	19.0	401.0
Puerto Rico			21.0	21.0
South Carolina		26.0	11.0	37.0
Tennessee	83.8	105.0	79.0	267.8
Vermont	7.0		12.0	19.0
Virginia	79.0	117.9	210.0	406.9
West Virginia	76.0	102.0	62.0	240.0
Wisconsin	5.0	48.5	31.0	84.5
Total	1,045.3	1,303.2	1,314.6	3,663.1
Grand total	5,619.9	5,757.8	5,080.6	16,458.3

TABLE 29.—*Mileage of completed forest-highway projects, by States* [1]

State	Mileage of forest-highway projects completed		State	Mileage of forest-highway projects completed	
	During 1933	Total to June 30, 1933		During 1933	Total to June 30, 1933
Western:			Eastern:		
Alaska	3.7	246.6	Alabama		5.1
Arizona	59.8	514.3	Arkansas	18.4	93.4
California	55.8	595.2	Florida	3.2	72.3
Colorado	29.7	445.9	Georgia		21.4
Idaho	36.2	626.9	Michigan	4.9	21.1
Montana	16.1	472.7	Minnesota	16.1	85.0
Nevada	1.1	143.7	New Hampshire		8.1
New Mexico	32.6	266.5	North Carolina		43.3
Oregon	47.6	855.6	Pennsylvania		1.8
South Dakota	4.1	51.9	South Carolina		15.6
Utah	2.2	356.5	Tennessee		37.4
Washington	19.5	259.5	Virginia	3.3	19.3
Wyoming	5.1	330.7	West Virginia		3.6
Total	313.5	5,166.0	Total	45.9	427.4
			Grand total	359.4	5,593.4

[1] A revision of the system in Florida omits 8.0 miles previously reported as improved, and corrections of previously reported figures total 0.2 mile.

During the past year improvements were constructed on 359.4 miles of the forest-highway system, bringing the total mileage improved to date with Federal funds to 5,593.4 miles. Of the mileage improved during the year, 313.5 miles were in the Western States and Alaska, and the remaining 45.9 miles were in the forests of 5 Eastern States. Of the total mileage improved to date, 5,166.0 miles are in the West and 427.4 in the East.

The mileage of forest-highway projects constructed during the year and to date by States is shown in table 29.

On June 30, 1933, work was in progress under the supervision of the Bureau of Public Roads on 1,067.4 miles of road at a total estimated cost of $11,282,213.78. Work estimated to cost $1,933,827 had been planned but not yet started; and there was a balance of authorized funds not yet obligated to definite projects amounting to $1,722,113.70.

ROAD CONSTRUCTION IN THE NATIONAL PARKS

Road construction in the national parks by agreement with the National Park Service is supervised by the Bureau of Public Roads. During the fiscal year 1933, 174 miles of road were constructed, making a total of 674 miles thus far improved.

The mileage constructed during the fiscal year and to date in the several parks is shown in table 30.

The most important project constructed for the National Park Service under supervision of this bureau is the Wawona Tunnel in Yosemite National Park. This tunnel on the Wawona road connecting Yosemite Valley with the Mariposa Grove at Big Trees is 0.8 mile in length. It was completed during the past year. The great length of the tunnel made it necessary to provide lighting and ventilation.

An outstanding project of interest to the Eastern States which was completed during the year is the Skyline Drive along the ridge of the Blue Ridge Mountains in the proposed Shenandoah National Park in Virginia. The completed road is 40 miles in length and for 35 miles it runs along or near the crest of the Blue Ridge Mountains through a section that has been visited in the past only by mountain hikers. Near the beginning of the project at Panorama the road leads through Mary's Rock Tunnel, 600 feet in length. There is then presented a panorama of the foothills of the Blue Ridge Mountains and plains of Virginia extending as far as they eye can see. The entire completed section is a route of continuous scenic beauty. This section comprises about one third of the total improvement contemplated which will extend from Front Royal at the northern end of the park to near Waynesboro at the southern end.

TABLE 30.—*Mileage of national-park roads improved under the supervision of the Bureau of Public Roads*

National park or monument	Mileage completed under supervision of the Bureau		National park or monument	Mileage completed under supervision of the Bureau	
	During fiscal year 1933	Total to June 30, 1933		During fiscal year 1933	Total to June 30, 1933
Acadia	0.3	3.9	Petrified Forest National Monument	0.4	16.7
Bryce Canyon	14.4	14.4	Rocky Mountain	28.1	36.8
Colonial National Monument		10.0	Scotts Bluff National Monument	.6	.6
Crater Lake	14.8	38.1	Sequoia	4.1	32.8
Devils Tower National Monument		.3	Shenandoah	40.1	40.1
General Grant	2.4	6.4	Wind Cave	1.4	6.7
Glacier	10.4	47.3	Yellowstone	3.4	92.9
Grand Canyon	35.9	129.7	Yosemite	1.8	56.4
Hawaii	9.0	20.2	Zion	.6	15.5
Lassen Volcanic		[1] 30.4			
Mesa Verde	2.2	20.4	Total	174.4	674.4
Mount Rainier	4.5	54.8			

[1] Correction of previously reported figure.

The Fall River Highway in the Rocky Mountain National Park, Colo., 28 miles in length, was built at a cost of $900,000. The road is located east of the Continental Divide on the main east-and-west road traversing the park. The entire project is located at a very high elevation. Some of the highest and most rugged peaks of the Rocky Mountains may be seen along this route.

Other park projects constructed during the past year include a parking area on the Cadillac Mountain Road in Acadia National Park, the Rim Road in Bryce Canyon National Park and a section of the Scotts Bluff Road in Scotts Bluff National Monument.

Two large bridges were constructed in Petrified Forest National Monument. These bridges are known as the Rio Puerco and Dry Creek Bridges and are located on the main north and south highway which was completed during the fiscal year 1932.

RESTORATION OF FLOOD-DAMAGED ROADS

During the last fiscal year there has been no addition to the appropriations previously made for relief of the States on account of damage to roads by floods.

Of the various appropriations, those made for Vermont and New Hampshire have been completely expended; of those made to Kentucky, Arkansas, Louisiana, Mississippi, Missouri, Alabama, and Georgia, various amounts remain unobligated, and that made to South Carolina is entirely obligated but in small part unpaid. Although less than the total sum appropriated for Florida has been paid to the State, the sum of $77,296.48 actually paid is the whole payment that will be made.

The appropriations made for all of the States except Alabama, Georgia, and South Carolina had no definite term of availability. In the three exceptional cases the original appropriations were for the fiscal year 1931, but the terms of availability have been extended by subsequent legislation, the most recent being the act of July 7, 1932, extending availability until June 30, 1933 and that of March 3, 1933, further extending the term of each to June 30,1934.

In the cases of Georgia and South Carolina, portions of the appropriations originally reserved to meet Federal administrative costs were unneeded for that purpose and released for payment to the States during the past year.

TABLE 31.—*Flood relief appropriated, amounts paid to States, and the unobligated balance of the appropriation on June 30, 1933*

State	Appropriated	Paid to the States to June 30, 1933	Unobligated balance
Vermont	$2,654,000.00	$2,654,000.00	
New Hampshire	653,300.00	653,300.00	
Kentucky	1,889,994.00	935,280.41	$666,763.24
Total	5,197,294.00	4,242,580.41	666,763.24
Arkansas	1,800,000.00	1,477,693.56	322,306.44
Louisiana	967,582.00	786,271.13	181,310.87
Mississippi	628,000.00	345,266.57	282,733.43
Missouri	258,418.00	119,428.31	130,865.95
Total	3,654,000.00	2,728,659.57	917,216.69
Alabama	[1] 1,618,500.00	481,083.81	1,137,416.19
Georgia	[1] 505,167.50	433,687.63	19,152.05
South Carolina	[1] 801,361.00	770,682.05	
Florida	80,307.00	77,296.48	
Total	3,005,335.50	1,762,749.97	1,156,568.24
Grand total	11,856,629.50	8,733,989.95	2,740,548.17

[1] Does not include fund allowable for administration.

The mileage of road improved under the relief acts up to the end of the fiscal year and the corresponding total cost and Federal payment are given in table 32. Similar information for roads completed during the past year, including 6.3 miles on which final payment had not been made, is presented in table 33; and for roads under construction, including 1.9 miles in Georgia approved for construction, in table 34.

TABLE 32.—*Total cost, flood relief, and mileage improved to June 30, 1933*

State	Total cost	Flood relief	Miles
Vermont	$5,651,965.83	$2,654,000.00	61.2
New Hampshire	1,408,479.45	653,300.00	29.1
Kentucky	1,799,206.78	750,341.07	103.2
Total	8,859,652.06	4,057,641.07	193.5
Arkansas	843,914.04	405,711.21	49.8
Mississippi	11,433.59	3,563.66	.3
Total	855,347.63	409,274.87	50.1
Alabama	319,797.49	155,615.15	41.7
Georgia	362,649.69	176,502.53	4.4
South Carolina	1,230,791.05	559,721.98	18.1
Total	1,913,238.23	891,839.66	64.2
Grand total	11,628,237.92	5,358,755.60	307.8

TABLE 33.—*Total cost, flood relief and mileage of roads which were completed during the fiscal year 1933*

State	Estimated total cost	Flood relief allotted	Miles
Kentucky	$387,202.26	$162,125.66	35.8
Georgia	321,441.48	156,143.65	4.3
South Carolina	336,363.72	156,300.00	3.6
Total	657,805.20	312,443.65	7.9
Grand total	1,045,007.46	474,569.31	43.7

TABLE 34.—*Total cost, flood relief, and mileage of roads under construction and approved for construction on June 30, 1933*

State	Estimated total cost	Flood relief allotted	Miles
Georgia	$129,601.70	$56,304.01	2.2
Kentucky	1,090,138.05	472,889.69	108.3
South Carolina	533,541.46	241,639.02	4.2
Total	1,753,281.21	770,832.72	114.7

The mileage of the several surface types represented in flood-relief roads completed during the fiscal year 1933 is given in table 35, and the total mileages completed, and under construction and approved for construction are given in tables 36 and 37, respectively.

The amounts of the several appropriations (less sums reserved for Federal administration in the cases of Alabama, Georgia, and South Carolina), the amounts paid the States up to June 30, 1933, and the unobligated balances for each State are shown in table 31. Flood relief paid to the States during the fiscal year 1933 is given below:

Kentucky	$267,528.92
Missouri	119,428.31
Georgia	15,479.62
South Carolina	36,659.82
Florida	1,243.65
Total	440,340.32

TABLE 35.—*Mileage of the various types of flood-relief roads completed during the fiscal year 1933*

State	Graded and drained	Macadam, treated	Portland cement concrete	Bridges and approaches	Total
Georgia		3.3	0.4	0.6	4.3
Kentucky	35.7			.1	35.8
South Carolina	.1		2.6	.9	3.6
Total	35.8	3.3	3.0	1.6	43.7

TABLE 36.—*Mileage of the various types of flood-relief roads improved to June 30, 1933*

State	Graded and drained	Sand-clay, untreated	Gravel, untreated	Gravel, surface treated	Macadam, surface treated	Bituminous macadam	Portland cement concrete	Bridges and approaches	Total
Vermont			7.0	9.2		6.1	32.5	6.4	61.2
New Hampshire				2.9	4.9	2.3	18.4	.6	29.1
Kentucky	102.2							1.0	103.2
Total	102.2		7.0	12.1	4.9	8.4	50.9	8.0	193.5
Arkansas	16.1		31.1				.3	2.3	49.8
Mississippi							.3		.3
Total	16.1		31.1				.6	2.3	50.1
Alabama	17.4	15.9	7.6					.8	41.7
Georgia					3.3		.4	.7	4.4
South Carolina	10.1						5.3	2.7	18.1
Total	27.5	15.9	7.6		3.3		5.7	4.2	64.2
Grand total	145.8	15.9	45.7	12.1	8.2	8.4	57.2	14.5	307.8

TABLE 37.—*Mileage of the various types of flood-relief roads under construction and approved for construction on June 30, 1933*

State	Graded and drained	Sand-clay, untreated	Gravel, untreated	Macadam, treated	Portland cement concrete	Bridges and approaches	Total
Georgia		0.4		0.3	1.2	0.3	2.2
Kentucky	103.2		4.6			.5	108.3
South Carolina	2.9	.3				1.0	4.2
Total	106.1	.7	4.6	.3	1.2	1.8	114.7

MOUNT VERNON MEMORIAL HIGHWAY

With the exception of a few finishing details the work of constructing the Mount Vernon Memorial Highway was completed during the fiscal year 1932. The remaining work was completed early in the last fiscal year, and the control of the highway was transferred to the Office of Public Buildings and Public Parks of the National Capital.

Ceremonies celebrating the formal opening of the road were held at the Mount Vernon terminus on November 15, 1932, attended by members of the American Association of State Highway Officials then in convention at Washington. Addresses were made by Secretary of Agriculture Arthur M. Hyde, Senator Simeon D. Fess, vice chairman of the United States Commission for the Celebration of the Two Hundredth Anniversary of the Birth of George Washington, Lt. Col. U. S. Grant, 3d, Director of the Office of Public Buildings and Public Parks of the National Capital, and Frederic E. Everett, president of the American Association of State Highway Officials and chief engineer of the State Highway Department of New Hampshire.

INTER-AMERICAN HIGHWAY

All field operations in connection with the reconnaissance survey of the proposed inter-American highway from Panama to the United States were completed before the end of the fiscal year. The Panama City office of the Bureau engineers who have been engaged in this work since 1930 was restored late in May to the Central Roads Board of Panama, by which it had been kindly loaned. It will be kept open in future by the Central Roads Board as a center of information on the proposed highway.

The reconnaissance operations included ground surveys through the Republics of Panama, Costa Rica, Nicaragua, Honduras, and Guatemala, in which the American engineers and representatives from the local governments covered approximately 900 miles afoot or on horseback. Aerial photographic surveys of the region along the route were also made by the United States Army Air Corps operating from its Panama base at France Field.

A comprehensive report of this important project is now being compiled. It will contain complete engineering details and in addition will outline the general and economic characteristics of the countries to be traversed by the proposed highway. From an engineering standpoint, the construction of an all-weather road 3,200 miles long, from Panama City, Republic of Panama, to Nuevo Laredo, Mexico, is entirely practicable; more than 1,200 miles of the total route, in fact, are already passable to motor vehicles in all seasons, and 1,000 miles more are passable in the dry season. Construction work is being actively pushed on a number of local stretches of road, particularly in Panama and Mexico.

As an instrument for developing the potential resources of and strengthening our commercial and social relations with the Central American Republics, it is believed that the construction of the inter-American highway is justifiable from an economic standpoint, and that the project does not contemplate expenditure of money and labor disproportionate to the benefits eventually to be realized by the United States and the republics concerned.

TRANSPORTATION AND ECONOMIC AND STATISTICAL INVESTIGATIONS

MICHIGAN TRAFFIC SURVEY

The report of the traffic survey conducted in Michigan in cooperation with the State highway department in 1930 and 1931 was published in the February 1933 issue of Public Roads. Among the more important results of the survey

was the determination of the relative utilization of the State highway system, the county and township highways, and city streets. The survey revealed that 50 percent of all Michigan traffic is carried by the streets of cities in the State, 5 percent by the township roads, 12 percent by county roads, and 33 percent by the State highway system.

On the 7,691 miles of main roads included in the State highway system the average daily traffic was found to be 1,144 vehicles. On the 17,175 miles classified at the time of the survey as county roads the traffic averaged 190 vehicles daily, and on the 60,214 miles of township roads, most extensive and least important of the State's road mileage, the traffic averaged only 22 vehicles per day. On 25 percent of these roads the survey showed the traffic to be 10 vehicles or less daily.

Of the traffic on city streets 69 percent was found to be local to the city, and 31 percent was found to originate at, or destined to, points beyond the city limits. As an incident of the survey it was found that 2½ million motor tourists visited the State during the survey year with estimated total expenditures of $274,000,000. Over 80 percent of these tourists were found to be from neighboring States and Canada.

WASHINGTON REGIONAL-AREA TRAFFIC SURVEY

Field work of the Washington regional-area traffic survey was finished in September 1932, and a report is now in preparation. Traffic information will be available in sufficient detail to serve as the basis for development of a connected system of main highways in the Washington regional area and to indicate desirable priority of construction. A complete analysis has been made of the necessity for the construction of several alternate routes, including bridges, to relieve congested existing routes, and studies have also been made of possible relocations and extensions of several existing highways. The data are sufficiently inclusive and extended to indicate with reasonable accuracy the minimum volume of traffic which would be carried upon the proposed new routes. It is believed that it will be possible to make recommendations, the adoption of which will result in greater economy and convenience to traffic upon certain of the projected routes, and in large savings in right-of-way and construction costs by modification of prior proposals that have not been based upon factual information with regard to traffic movements.

INDIANA TRAFFIC SURVEY

As the fiscal year closed, field work on a 12-month survey of traffic in 11 representative counties of Indiana was nearing completion, being scheduled to terminate in August. As the first comprehensive traffic census ever made in Indiana, its results, showing relative proportions of foreign and domestic traffic on township, county, and State roads will be of importance to State authorities. A report of the survey will be started upon completion of the field operations.

NEW JERSEY TRAFFIC SURVEY

A survey of traffic upon the entire State highway system of New Jersey and upon a limited mileage of the principal county routes, begun in 1932, is scheduled to be completed September 1, 1933. The resulting report will contain data with regard to the origin and destination of truck traffic, the nominal capacities and body types of trucks, their classification as owner operated, contract haulers, or common carriers, and as of interstate or intrastate operation, the origin and destination of all vehicles observed at the Hudson River and Delaware River crossings, and the determination of the proportions of passenger-car traffic upon each of the highway systems that are local to each county or that originate in other areas. Special studies will be made of the data in connection with the necessity for additional highway facilities in the State.

TRAFFIC CAPACITY AND INTERSECTION STUDIES

Research has been continued into the efficiency of various types of traffic control at highway intersections. A large number of vehicles have been electrically timed through intersections of different types, and data for comparative study have been obtained by the experimental varying of signal cycles or the making of observations before and after the inauguration of new control systems.

Observations of traffic on United States Route No. 1 between Jersey City and Newark, N.J., made in connection with the traffic survey in that State, have indicated that the new high-level viaduct is saving highway users approximately 1 million "vehicle-hours" per year. Speed of vehicles was determined by the

recording of license-plate numbers and time of passage at both ends of the route, before and after its improvement. The results of these observations will be published.

TESTS OF HIGHWAY SIGNS

Tests to determine the relative efficiency of reflector buttons designed for use in highway signs and the attention-arresting values of sign color combinations, undertaken in cooperation with the Bureau of Standards at the request of the American Association of State Highway Officials and the National Conference on Street and Highway Safety, have been completed. This investigation involved the determination of the personal acuity and rapidity of perception of 121 individuals as measured by a tachistoscope adjusted to control definitely the time interval of free observation. The conclusions reached indicate that black letters on a yellow background are more easily read than black letters on white background or white letters on black background, and that a reflecting button with a diameter of 0.76 inch is relatively more efficient for rural use than reflecting units of 0.95 or 0.58 inch. This advantage is not so apparent under conditions usually obtaining in city streets where the absence of glare under dimmed headlights increases the value of the small button.

UNIFORMITY IN MOTOR-VEHICLE REGULATIONS

The complicated situation resulting from the diversified motor-vehicle legislation existing in the 48 States and the District of Columbia was the object of study by the Bureau throughout the year, with representatives participating in several conferences of State administrators and vehicle-operators' associations. The entire problem of motor-vehicle regulation was analyzed in a report published in the December 1932 issue of Public Roads. Movements toward greater uniformity in State legislation have been launched in various parts of the United States, and the Bureau has been lending its cooperation to these efforts.

STUDIES OF TAXATION IN WISCONSIN, MICHIGAN, AND ILLINOIS

Results of extensive inquiry into the finances of Wisconsin, Illinois, and Michigan with special reference to highways were made available to the public in the April, May, and June (1933) issues of Public Roads. All three studies related to the calendar year 1930 as the latest year for which complete data were available. The purpose of the investigations was to establish the relation of highway taxes paid from different sources and by different groups of citizens, based on local administrative units and the highway service furnished, and to lay down a broad basis for adjustment of highway taxes on a rational plan.

Many important facts regarding highway financing may be adduced from these surveys. In all three of the States covered, it was found that rural property paid no tax for urban streets, but a part of the tax on urban property was expended on local township roads. A striking similarity was found to exist between the proportion of motor-vehicle imposts paid by rural and urban motor-vehicle owners and the proportion of highway travel by these owners; for example, rural motor-vehicle owners (residents of townships) in Wisconsin paid 33.9 percent of the total motor-vehicle imposts expended on all classes of roads and streets, and travel by these same rural owners made up 31.9 percent of the total travel on all classes of roads and streets, while the corresponding percentages for city and village motor-vehicle owners were, respectively, 66.1 and 68.1 percent.

PRODUCTION COST STUDIES

ROAD CONSTRUCTION AS AN EMPLOYMENT MEASURE

The resort to highway construction as a means of furnishing employment for idle labor has emphasized the need of more precise knowledge of the amount of human labor entering into each of the various road building and maintenance operations, and how and to what extent the labor element varies when different methods and equipment are used. The collection of data bearing on these questions, in terms of the number of man-hours required to produce a given result, has been made a regular part of the production-cost studies.

Last year a study was made of the extent to which labor profits from the construction of high-type pavements in which mechanical equipment plays an important part. In this study the money paid out by States or communities for the construction of a concrete pavement was traced through its various exchanges showing how these expenditures extend to sand and gravel pits, stone quarries, cement and steel mills, to the manufacturers of equipment, repair parts, explo-

sives, gasoline, lubricating oils, and supplies, as well as to railroad and transportation companies, and to those who furnish them their supplies, equipment, and repairs, which extend from coal and ore mines to mills and factories. When thus traced, it was found not only that about 90 percent of the taxpayers' dollar was eventually paid to workers as wages and salaries, but also that a very large part of the industry of the country took an active part in the work and received a definite financial stimulus. A few more specialized studies have been made to show the extent to which particular industries or activities profit from normal highway work, such for example, as the freight obtained by railroads as a direct and indirect result of highway-construction activities.

A study was also made to discover the trend of costs in highway construction apart from the influence of such factors as changes in use of materials, specifications, and construction practices. This study led to the development of a set of index figures based on the average cost of 1 mile of highway composed of units of grading, surfacing, and structures in the same ratios of use as were found in the highway-construction program for the years comprising the base period. This index, which was published in Public Roads, July 1933, shows the trend in unit prices for excavation, surfacing, and structures, as well as for the composite mile of road improvement for the period 1922 to 1933.

The work in connection with carrying out the legislative provisions fixing minimum wage rates and maximum hours of employment on all road-construction projects involving the expenditure of Federal road funds has been carried on in about the same manner as in the past, although the volume has increased considerably. As a regular part of this work a monthly record of the number of persons actually employed in State and Federal road work is compiled.

STUDIES OF ROLLED CONCRETE PAVEMENTS

During the past year studies were made on the placing of two sections of rolled concrete pavement in which 5- to 7-ton tandem road rollers were used to consolidate a very lean and dry mix. In this work all methods of operation were practically the same as in the production of a standard concrete pavement, except certain operations behind the paver. The mix used was so lean that the mortar, while of about normal richness, was only sufficient in quantity to fill the voids in the coarse aggregate when the latter had been thoroughly consolidated by repeated passages of the tandem road roller. On both of the experimental sections a finishing machine was used ahead of the roller as a strike-off, although an ordinary heavy strike-off planer drawn by a winch on the paver would no doubt have been cheaper and apparently equally satisfactory for striking off the lean, harsh concrete mix at the desired height so that the consolidation produced by the roller would just bring the surface to the desired elevation. The second finisher was used behind the roller in the usual manner to spread such excess mortar as might be brought to the surface by the roller and to produce the customary smooth finish. With further experience in conducting the rolling and in designing the mix, this finishing machine may not be necessary, especially on secondary road work.

The rolling, which was begun immediately after the concrete had been spread and struck off, was carried on in much the same manner as in the construction of an ordinary broken-stone macadam surface and was continued until the surface was perfectly smooth and unyielding, and all the coarse particles were firmly interlocked and the mortar was just flushing to the surface. The regular grading of the coarse aggregate as employed in the standard methods of construction was used in both cases, although there were some indications that a grading in which a considerable portion of the intermediate or finer sizes was omitted might prove better.

This method, while still in an experimental stage, seems to have considerable promise of development for use on secondary roads and in regions where sand and cement prices are high. Tests of cores and beams and general observations indicate that it will produce a pavement in point of surface smoothness, density, and both beam and compressive strength, comparing favorably with pavements placed by standard methods containing from 1 to 1½ more bags of cement per cubic yard. The studies will be continued with a view of determining the possibility of developing the method for use in the improvement of secondary highways.

CONCRETE FROM CENTRAL MIXING PLANTS

Concrete for highway work is being supplied in increasing amounts from large central mixing plants that are usually equipped with mixers very much larger than those of the portable type in common use on highway-construction projects. Studies of two such plants equipped with 4- and 5-cubic-yard mixers indicate

quite clearly that, with an actual mixing time varying from 1 to 4 minutes, little or no appreciable increase in either beam or crushing strength and no improvement in the uniformity of distribution of the various ingredients throughout the batch are secured by mixing the batch longer than 1 minute. These tests also show that a grinding action takes place within the drum, the amount of which is directly proportional to the length of the mixing time. With the hard gravel aggregates used in these tests, the grinding was confined almost entirely to the sand, but with long mixing time the stone dust, or flour, thus produced was sufficient to have an appreciable effect on the slump. Thus, to produce a concrete of given slump, more water was necessary when the mixing time was long than when it was short.

METHODS OF BUILDING LOW-COST HIGHWAYS

In view of the increasing difficulty of obtaining sufficient funds to provide and maintain adequate local highway facilities, considerable attention has been devoted to the development of the most efficient methods of building low-cost bituminous surfaces. Two types of such surfaces have been developed—the so-called plant-mix and road-mix types. In the construction of surfaces of the first type the stone and bituminous material are mixed in some form of mechanical mixing plant, either stationary or portable, in much the same manner as standard bituminous concrete. Surfaces of the road-mix type, on the other hand, are constructed by mixing the stone and bituminous material in place on the road.

The methods employed in both types of operation vary a great deal. There are hardly any two localities in which exactly the same methods are used; but everywhere the effort is being made to produce satisfactory dustless surfaces suitable for light traffic by methods and with materials less expensive than those employed in the construction of the higher types of bituminous surfaces.

The Bureau has joined in these efforts with studies of both plant-mixing and road-mixing methods. The studies of the plant-mix type have been devoted largely to finding means of maintaining production rates in the face of a tendency to add refinements which jeopardize the essential low cost of the product. In the case of the road-mix type its work has been mainly a search for ways and means of simplifying and standardizing construction procedures and developing more effective and efficient mixing equipment. Progress along these lines has been gratifying and gives promise of definite results.

GRADING STUDIES

Studies of grading practices have been continued. The changes that have taken place in recent years in this important department of road work are most striking. In 1926 the power shovel in use on the average highway-grading job in the United States had a dipper rated at ¾-cubic-yard capacity and the 1¼- or 1½-cubic-yard horse-drawn wagon was the prevailing hauling equipment. Today our studies indicate that the average grading job is equipped with a shovel having a dipper capacity of 1¼ cubic yards, and that the 1½-yard shovel is now more common than the ¾ yard. Horse-drawn hauling equipment is now seldom seen, the prevailing type of hauling equipment being the heavy truck or large tractor-drawn wagon. A series of articles entitled "Power Shovel Operation in Highway Grading", has been revised and rewritten for publication in the near future.

The bulldozer has long been standard equipment on the dump and in building sidehill trails and minor roads. Recently the use of the bulldozer has been successfully extended to the longitudinal movement of earth and all loose or friable materials in regular highway-grading work. Studies of the operation of this type of equipment indicate that it should find considerable use in connection with the power shovel whenever the topography is broken or rugged and the hard rock is overlain by a considerable mantle of earth, deeply decomposed rock, or other friable materials. The essential requirements for successful use of the bulldozer as a grading unit are steep surface grades, relatively short hauls, and a material of which a load can be accumulated readily. If the material is hard, scarifying or blasting must be resorted to before the bulldozer can operate efficiently. Hard rock or hard shales can seldom, if ever, be fragmented sufficiently even by heavy blasting to make the use of the bulldozer economical. This type of material should be reserved for movement by the power shovel.

Studies of use of the elevating grader in highway work indicate that recent improvements—among them the provision of a separate power unit for operating the elevator belt—have extended the field within which this type of equipment may find profitable employment to include very slippery and very loose and sandy soils, in which operation was formerly impractical or impossible because of bull-

wheel slippage. Broadly speaking, however, the field of the elevating grader is still limited to the movement of earth reasonably free from roots and stones in level to gently rolling country. In a recent study, five elevating graders were observed working under favorable conditions in ground of this type for all of which the production averaged over 200 cubic yards of pay material loaded, hauled, and placed in the fill per hour of actual operation.

HIGHWAY-ACCOUNTING METHODS

Accurate, complete and up-to-date information in regard to the various activities of a highway department is essential to efficient and economical administration and control. The Federal Government is vitally interested in the attainment of the highest possible degree of efficiency in the functioning of the various State departments with which it cooperates in the construction of Federal-aid roads. For these reasons, the Bureau has continued the effort to further the development and installation of efficient accounting and statistical procedures that will provide the State administrative and engineering organizations with full and complete records of current income, expenditures, and accomplishments in highway construction, maintenance, and administration, and by their uniformity permit the accomplishments of one State to be fairly compared with those of another. Such a comparison is as yet largely impossible, except in a few States, because of the dissimilar form of the available records and the lack of a uniform nomenclature and procedure. The aim is to provide a system of accounts and records that will be economical in operation, will fully meet all accounting requirements of the Department, and will provide quickly and in practical form complete statistical information on any desired activity in which the Department is engaged. Cooperative work along these lines was carried on during the past year with the State highway departments of Arkansas, New Hampshire, and Indiana.

PHYSICAL RESEARCH

MOTOR-VEHICLE IMPACT INVESTIGATIONS

During the past year a report has been published covering in detail the study of the impact reactions produced by a heavy motor bus, mentioned in last year's report.

A limited study was made of the impact reactions of a heavy passenger car and of those of a light truck equipped with high-pressure pneumatic tires. Tests with these vehicles were made over actual pavement surfaces. The relation between the magnitude of the reactions developed and the frequency of occurrence was established for each vehicle and the trends of the data were compared with similar data obtained in the bus tests. A complete report of this study has been prepared.

Preparations have been made for the study of the effect on road surfaces of the suddenly applied forces of motor-vehicle impact. A definite program of tests has been outlined. This program includes a series of tests to determine the relative effects of static and impact forces on massive concrete specimens under carefully controlled conditions. For this work a specially designed pendulum-type impact machine has been designed and is being built. The program will also include comparative static and impact tests on actual pavement slabs to follow the series of laboratory tests.

INVESTIGATION OF CONCRETE PAVEMENT DESIGN

This investigation, which has for its object the development of information which will assist in a better understanding of the structural action of concrete pavement slabs and thus lead to improved structural design, has progressed toward its conclusion during the past year. A great many loading tests and other observations have been made and a considerable amount of new information of a definite and conclusive nature has been developed.

The series of reports, mentioned last year, by means of which this information will be made available, has been outlined in detail, and preparation of the reports has been started.

INVESTIGATIONS OF CONCRETE AND CONCRETE AGGREGATES

In previous reports reference has been made to investigations of pavement concrete which involved the construction and testing of full-size pavement slabs. These investigations have yielded valuable information regarding the effect of variations in materials and construction practices on the strength and uniformity of the concrete. The major conclusions from the first series of tests were given in the 1931 annual report. In the second series, the effect of using

high-speed vibrators mounted on the screeds of the finishing machine and the effect of delayed finishing for the purpose of removing excess water were studied. The portion of this investigation dealing with strength and uniformity has been completed and a report issued. The major conclusions were as follows:

EFFECT OF VIBRATION

By the use of vibrating equipment of the general type used in these tests it should be possible to place satisfactorily and to finish concrete considerably drier than is possible with methods now in common use.

For conditions comparable with these tests, it should be possible satisfactorily to place and finish by vibration concrete having a minimum slump of 1 inch as compared to a minimum slump of 2½ inches by methods now in common use.

These tests indicate that, depending on the type of coarse aggregate used, concrete containing from one fourth to three fourths parts more coarse aggregate than the base mix, if vibrated, should show as great uniformity and as high flexural strength as the base mix finished by methods now in common use. Such a mix will contain approximately from 0.2 to 0.6 sack of cement per cubic yard less than the base mix.

The indications of these tests are that the effect of vibration is more marked where angular coarse aggregates are used than where aggregates having rounded surfaces are used.

EFFECTS OF DELAYED FINISHING

The use of the method of delayed finishing as carried out in these tests will increase the density and strength of concrete pavement slabs, by eliminating, before final consolidation, a larger quantity of excess water than is accomplished by methods now in common use.

The application of the method of delayed finishing to a mix containing approximately one half part more fine and 1 part more coarse aggregate than the base mix will produce pavement slabs having substantially the same crushing and flexural strength as the base mix finished by methods now in common use. Such a mix will contain approximately one sack of cement per cubic yard of concrete less than the base mix.

In general, the indications of these tests are that the proper use of either the vibratory method of finishing or the method of delayed finishing should result in an improvement of the quality of concrete pavements. Tests are now under way to determine the effect of these special methods of finishing on the ultimate durability of the concrete as measured by freezing tests on cores cut from the test section.

OTHER CONCRETE TESTS

Several studies having to do with the general question of improving concrete in respect to its durability or resistance to weathering are being continued. In one series, a number of mortar specimens containing various types of concrete sand are being subjected to alternate freezing and thawing for the purpose of developing information which will make it possible to include in specifications definite quantitative requirements designed to insure durability of fine aggregates.

In an effort to improve existing methods of testing the wear-resisting qualities of coarse aggregates, a study was undertaken of the so-called "Los Angeles rattler" test used by the State of California. It has been claimed that this test is superior to the existing standard method because it is possible to test both crushed stone and gravel by the same method, thus eliminating the necessity for two separate specification requirements as at present. These tests were conducted in cooperation with the American Association of State Highway Officials, and a report is now being prepared for publication.

During the year an investigation was started which has for its major object the development of a standard laboratory procedure for testing the numerous new methods and materials continually being developed for curing concrete. Of these methods, one which presents interesting possibilities, not only as a means of curing but also as a means of insulation, involves the use of a cotton mat formed of one or more layers of raw cotton placed between sheets of cotton cloth. A laboratory study of this material showed quite definitely that the cotton mats were not only effective in providing insulation against the sun's rays but were also as efficient, from the standpoint of curing, as a double thickness of burlap kept wet 3 days. The results of this investigation have been published.

Attention has been called recently to the extreme importance of controlling the temperature and moisture content of concrete specimens at the time of test if reliable results are to be obtained. One series of tests, conducted for the purpose

of developing information along this line, has been completed and a report prepared. Another series involves tests, at various periods up to 1 year, of concrete containing both normal and lightweight aggregates stored and tested under both wet and dry conditions. These tests should also yield information of value as to the effect of artificial lightweight aggregates on the strength of concrete at different ages and under various curing conditions.

HIGHWAY BRIDGE INVESTIGATIONS

A complete report of the cooperative investigation of the Freyssinet method of arch construction as applied to the Rogue River bridge in Oregon has been completed and is being published as a bulletin of the Oregon Highway Commission.

A cooperative study of multiple-span reinforced-concrete arch bridges has been completed at the University of Illinois. This study was made for the purpose of determining the effect of spandrel structures of various types and elastic piers of various heights on the action of concrete arches. For this purpose several multiple-span arch ribs, each of three 26-foot spans, were built in the laboratory and deformation measurements made under loads of different intensities and distribution. The factors studied were spacing of expansion joints in the deck, height of deck above the rib at the crown, and height of elastic piers. Much information that will be useful to bridge designers was developed by this study. A complete report is now being compiled.

Tests to determine the friction developed in the sliding of expansion bearings of highway bridges, when the bearing plates are made of various materials and finished in different ways, were mentioned in last year's report. During the past year the schedule of tests has progressed steadily. Several hundred tests have been made, and an appreciable range in the coefficient of friction has been found to exist. The publication of the information obtained in this investigation should assist bridge engineers materially in designing sliding bearings.

MEASUREMENT OF ROAD SURFACE ROUGHNESS

Several years ago the Bureau developed a device, to be mounted on a motor vehicle, by which the successive deflections of the front springs of the vehicle, caused by the surface roughness of any road over which it might be driven, could be summed up and recorded in inches. The device was intended to indicate the relative roughness of road surfaces by the relative amounts of spring deflection recorded on different roads. There was full realization of its limitations, but it is useful nevertheless and has been used in many parts of the country. Its principal shortcoming is that the general level of the values recorded is affected by the vehicle characteristics (springs, weight, tire equipment, etc.), so that it is not possible satisfactorily to compare data obtained with the instrument mounted on different vehicles. This deficiency led to an investigation of the possibility of developing a standardized vehicle which could be used with the relative roughness indicator.

During the past year considerable study has been given to this problem. A single-wheel trailer has been built, capable of standardization in all of its parts, and the work done with it thus far gives promise that it may be satisfactory. It is relatively simple to build and can be readily attached to the rear bumper of any automobile.

With such a vehicle it should be possible to compare directly data taken with different units at widely separated points or to compare data taken from time to time with the same unit. If this becomes possible, the usefulness of the relative-roughness indicator will be greatly increased.

BITUMINOUS MATERIALS AND LOW-COST ROAD INVESTIGATIONS

The bituminous investigations of the Bureau, during the past year, have proceeded along the following lines: (1) Continued observations of experimental highways; (2) field surveys and related laboratory studies in connection with various types of low-cost roads; (3) development of provisional specifications for liquid asphaltic materials based on a standard simplified scheme of analysis; (4) laboratory investigations of bituminous materials and bituminous mixtures to aid in selecting suitable materials, and to develop satisfactory methods of design for special types of low-cost bituminous highway construction.

Of the experimental bituminous-treated roads which the Bureau has constructed and maintained in cooperation with the highway departments of South Carolina, Nebraska, and California, two projects, one in California and the other in South Carolina, have been discontinued, and final reports are being prepared. The Nebraska experiments, which are of mixed-in-place construction in the sand-hill areas, are being closely observed, and a report of the construction and behavior

of these sections is being prepared for publication. Periodic inspections of the bituminous surfacings on marl and sand-clay bases on the remaining project in South Carolina have been made during the past year, and the maintenance costs and behavior have been recorded.

The cooperation of the Bureau with representatives of the tar industry in field surveys of low-cost, tar-treated roads has been discontinued. The report of the survey of tar-treated roads in North Carolina has been published. A report of the observations of tar-bound roads in Pennsylvania is being prepared.

The cooperative effort of the Bureau, the State highway departments, and the asphalt industry to simplify the tests and standardize the specifications for liquid asphaltic road materials has resulted in the promulgation of provisional specifications for the principal grades of these materials. These proposed specifications have been considered by the cooperating agencies at a series of regional meetings, and they have been adopted in whole or in part by a large number of States for use in current construction. This important work will be continued in the hope of accomplishing Nation-wide standardization of specifications and test procedure for liquid asphaltic road materials.

Investigations to determine the weather-resisting properties of slow-curing liquid asphaltic materials from different refineries have been undertaken during the past year. This work is of importance since it is hoped that ultimately it will lead to the development of tests which will insure the durability of this type of bituminous material which is used extensively in low-cost surfaces. A progress report of the work to date has been prepared. Similar materials from other refineries, as well as liquid asphaltic materials of the rapid-curing type and tars from various producers, are to be studied during the coming year. The development of a satisfactory accelerated laboratory test, to supplement the tests more commonly used for the control of quality of liquid bituminous products, should aid greatly in securing longer life and greater durability of the materials.

Laboratory investigations to determine and evaluate the factors essential to the proper design of hot bituminous paving mixtures have been continued. These investigations involve tests of laboratory and field samples both with the Hubbard-Field stability apparatus and with the roller stability machine designed by the Bureau to simulate the action of traffic. A progress report is now being prepared.

There has recently been built for testing purposes a small circular test track having an outside diameter of 14 feet and a width of 18 inches. Facilities are provided for temperature control, and provisions are made for variations in the type and condition of the base. Traffic is applied to the test surface with full-sized rubber-tired automobile wheels. This permits the testing of low-cost bituminous surfaces under controlled conditions which are essentially comparable to those of actual service. To date, the effect of various quantities and consistencies of the bituminous material, in mats of the road-mixed or plant-mixed types, has been studied. As the work progresses, tests will be made to determine the relative importance of other factors influencing the stability and durability of the different types of low-cost bituminous surfaces, such as type of bituminous material, type and grading of mineral aggregate, and character and condition of the base.

SUBGRADE INVESTIGATIONS

During the past year the subgrade research work has been conducted principally along the following lines: (1) Simplification of the routine procedure for testing soils; (2) adaptation of the principle of the drainage indicator to a new device for use in testing topsoils in the field; (3) investigation of the relative efficiency of various preventive measures in common use for overcoming the detrimental effects of subgrade heaving due to frost; (4) investigation of the compression test of soils for practical use in connection with the design of foundations for bridges and other structures; and (5) development of new tests to disclose the properties of soils stabilized by chemical admixtures and other methods.

In the routine procedure for testing subgrade soils, described in Public Roads, vol. 12, nos. 4, 5, 7, and 8, there were included tests sufficient in number and sufficiently varied in character to identify all of the various soils likely to be encountered in a national highway-construction program and to allocate them to the proper subgrade group indicated by their physical characteristics.

Much of the soil testing is now performed for the purpose of determining the suitability of soil or soil material for some particular use as, for instance, binder in sand-clay and gravel roads, filler in bituminous road surfacing or soil in mud-jack operations; to distinguish between the good and the undesirable varieties of individual groups of surfacing materials such as limerock, caliche, shale, etc., and to identify the properties of various materials which, as admixtures, may assist in the stabilization of both subgrades and soil road surfaces.

Generally the efficiency of particular materials for the special uses just mentioned depends upon the presence of several of the half dozen or more physical characteristics investigated in the complete testing procedure. Therefore in the study of special materials, the testing procedure is limited to the use of those tests only which disclose the particular characteristics on which the performance of the special material depends.

Studies of this character consist of three distinct steps as follows: (1) Analysis of the requirements of the material for the use intended; (2) determination of the dominating characteristics satisfying these requirements; and (3) selection of the particular tests best suited to furnish the desired information with regard to these dominating characteristics.

The drainage indicator, developed to furnish the designer with tangible evidence of the drainage properties of soils, was referred to in last year's report. As a further utilization of the principles controlling tests with this apparatus a new device has been designed for field use. This device, termed "the combined soil tester", gives information as to permeability, capillarity, and stability of the soil sample. It was designed primarily for use in prospecting for topsoil and sand-clay road-surfacing materials.

As research has developed information with regard to the causes of frost heave, the locations where it is apt to occur, and possible methods of elimination, various preventive measures based on this information have been utilized in road construction. Comprehensive surveys in regions where frost heave is a serious problem have now been made to determine how well the preventive measures have performed their intended functions. The resulting information will serve as a basis for recommendations guiding the construction of roads where conditions indicate the possibility of frost heave.

Determination of the practical significance of the Terzaghi compression test as a means of disclosing the effect of proposed loads on the performance of soft undersoils resulted from a comprehensive investigation of the hydraulic fill at Four Mile Run on the Mount Vernon Memorial Highway. In this research settlements of the fill as determined by levels, and moisture contents of the soft undersoil as determined from samples in the laboratory, were compared with corresponding settlements and moisture contents as computed from data furnished by the compression test performed upon samples of soft undersoil in the undisturbed state. The agreement between computed and observed values seems substantial enough to warrant the conclusion that the settlement of soil layers in the field follows much the same laws that control the consolidation of small soil samples in the compression test in the laboratory.

In the design of new tests to disclose the suitability of low-cost road materials, an attempt is being made to arrange for the testing of the entire sample, including coarse, as well as fine material; for the preparation of the sample by bringing it into a state of consolidation similar to that attained by such materials when used in low-cost road construction; and for the testing of the sample directly for the properties on which the service of such materials depend.

In the current laboratory procedure the binder fraction, or that fraction passing the no. 40 sieve, is tested for several physical characteristics such as permeability, shrinkage, and water absorption. The mechanical analysis of the soil mortar, that fraction passing the no. 10 sieve, is determined. The coarse fraction, that retained on the no. 10 sieve, is tested for grading, hardness, etc. From the results of these three sets of tests an estimate is made of the value of the materials for the use intended.

These tests are satisfactory for fine-grained subgrade soil, but they do not satisfactorily indicate the properties of soils containing only a small percentage of fine particles. They are also inadequate in showing the effect of admixtures that may be incorporated in soils for stabilizing purposes and that may materially alter their properties. Investigation will be made of the suitability of tests in which the sample is mechanically consolidated to a density representative of that produced in a soil road surface by traffic.

In these tests the entire sample, including coarse fractions, is to be brought to a state of optimum consolidation, and then tested for permeability, capillarity, stability, and shrinkage.

Cooperation with the State highway departments in the making of subgrade surveys, in the design of the subgrade treatments and road surfaces, and in the establishment of subgrade soil laboratories, has continued as in past years.

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REPORT OF THE SOLICITOR, 1933

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SOLICITOR,
Washington, D.C., September 22, 1933.

SIR: I submit herewith report of the work of the Office of the Solicitor for the fiscal year ended June 30, 1933.

Respectfully,

SETH THOMAS, *Solicitor.*

Hon. HENRY A. WALLACE,
Secretary of Agriculture.

INTRODUCTION

In order to carry out, in the conduct of this Office, the program of economy in Government service inaugurated by the President, a saving of $12,540 has been effected by leaving unfilled such positions as have become vacant during the year. It is my purpose to conduct the work of the Office on an economical basis, and since I believed that the work could be efficiently and expeditiously performed with the present force, no action was taken to secure new appointments to such vacancies.

By the transfer of the Seed and Agricultural Credit Loan Organization under Executive Order to the Farm Credit Board, this Office lost considerable legal work and some of its personnel, as the employees specially assigned to perform the duties of this activity were transferred along with this project. For several years the Solicitor has supervised and directed the legal work involved in this activity.

As usual, assistance has been given to the United States attorneys in handling much of the Department's litigation. One of the important cases in which such aid was rendered was that of *Joseph S. Morgan and Ivan C. Morgan, partners doing business in the name and style of Morgan Packing Co.* v. *George R. Jeffrey*, as United States attorney for the Southern District of Indiana, and Arthur M. Hyde, as Secretary of Agriculture of the United States, an injunction suit to enjoin the Secretary and the United States attorney for that district from enforcing certain regulations which the Secretary had promulgated under an amendment to the Food and Drugs Act. The grounds were that, in enacting the amendment, Congress exceeded its constitutional power, and in fixing the standard and prescribing the legend the Secretary transcended the authority conferred on him by the amendment. The amendment in question authorizes the Secretary of Agriculture to fix standards of quality and/or condition for canned foods and to prescribe a legend to appear on the containers of substandard canned foods to indicate that the food therein is below the standard so fixed. The amendment provides that substandard canned foods, the containers of which do not bear the prescribed statement, shall be misbranded within the meaning of the Food and Drugs Act. The Secretary issued regulations fixing a standard for canned peas, based on immaturity and tenderness, and prescribed that containers of substandard canned peas should bear the statement "Below U.S. standard, low quality but not illegal." The complainants, for some years, had been engaged in the canning of soaked dry peas which are substandard because they are mature and lack the requisite tenderness. They are, however, a wholesome and nutritious food. On motion, the suit was dismissed as to the Secretary because of lack of jurisdiction, but was retained as to the United States attorney. Upon trial, the district court was of the opinion that the regulations issued by the Secretary exceeded his authority under the amendment and therefore issued a permanent

injunction without passing upon the constitutionality of the amendment. The case is now pending, however, on appeal to the Circuit Court of Appeals for the Seventh Circuit.

Another important statute has been added to the list of the Department's regulatory laws. On June 10, 1933, the President approved an act entitled "An act to promote foreign trade of the United States in apples and/or pears, to protect the reputation of American-grown apples and pears in foreign markets, to prevent deception or misrepresentation as to the quality of such products moving in foreign commerce, to provide for the commercial inspection of such products entering such commerce, and for other purposes." This act authorizes the Secretary of Agriculture to establish the minimum of quality for shipment in export and to prescribe by regulations requirements other than grade which the fruit must meet before an inspection certificate can be issued showing compliance with the act. Export shipments must be accompanied by such certificates. In view of the short period intervening between the date of the act and the beginning of the export shipments for this year's crop, there was not time to give the required notice as to standards and regulations. A temporary order was therefore promulgated fixing standards and prescribing regulations pending the notice and hearing contemplated by the act. Later, standards and regulations authorized by the act were established and promulgated.

The program of basic determination, under the Packers and Stockyards Act, 1921, of the reasonableness of the rates being charged by stockyard owners and market agencies at the principal terminal livestock markets of the country, which was referred to in a former report, was carried forward during the year. When the fiscal year opened, a hearing to determine the reasonableness of the rates of livestock commissionmen and order buyers on the National Stockyards was in progress at East St. Louis, Ill. As a result of this hearing, and after argument of the matter before the Secretary, an order was issued and is now in force materially reducing those rates.

An inquiry into the reasonableness of the rates of the Union Stockyards Co. of Omaha, Ltd., was heard at Omaha, Nebr., also in the preceding fiscal year. The matter was subsequently argued before the Secretary, and an order substantially reducing the rates was issued. Thereupon the stockyard company instituted, in the District Court of the United States for the District of Nebraska, a suit to enjoin the enforcement of the order. A temporary injunction was issued, and the case is now pending final hearing.

In the preceding fiscal year the Secretary had issued an order reducing the rates of livestock commission men and order buyers doing business on the Kansas City stockyard. In the fiscal year just ended, most of the respondents named in the order filed a petition alleging changed economic conditions and praying that the order be vacated and a further hearing granted. Such rehearing was held at Kansas City, Mo. It was there shown that the changed conditions warranted even lower rates than those prescribed in the preceding order. After argument before the Secretary, another order was issued further reducing the rates. This order is of peculiar interest because it initiates a new form of rate schedule. Theretofore rates have been based on the carload as the unit of charge. The schedule prescribed in this order adopts the consignment as the unit of charge, with the rates graduated to some extent according to the number of animals in the consignment. A further departure from the old form of schedule is the recognition of more weight classifications. Formerly the only such classification was that dividing the bovine species into cattle and calves. This order divides it into cattle, yearlings, and calves, and also divides swine into hogs and pigs.

In a prior fiscal year, the District Court of the United States for the Western District of Missouri had enjoined the enforcement of an order of the Secretary prescribing reduced rates to be charged by the St. Joseph Stock Yards Co. A rehearing in that case was had at St. Joseph, Mo., and the matter is pending argument before the Secretary.

The work of the Office has been conducted economically and expeditiously during the fiscal year, and there follows a statistical summary of the work done.

GENERAL SUMMARY OF OFFICE WORK

Two hundred and ninety-seven written opinions were rendered to administrative officials of the Department. No record was kept of the advice given these officials in daily, informal consultations, or of opinions briefly expressed in writing on papers sent to this Office for consideration.

Twelve hundred and sixty-three notices of judgment were prepared for publication, pursuant to authority contained in the Food and Drugs, Insecticides, and Federal Caustic Poison Acts.

In addition to the criminal prosecutions hereinafter tabulated, 1,572 decrees of condemnation and forfeiture were entered under the Food and Drugs Act, 15 under the Insecticide Act, 15 under the Federal Caustic Poison Act, and 4 under the Federal Seed Act.

There were reported to the Attorney General 3,114 violations of statutes intrusted to the Department for enforcement.

Table 1 shows the several statutes under which these violations were recorded and the amounts of fines and recoveries in cases settled with and without contest. Table 2 summarizes the number of contracts and leases prepared or examined.

TABLE 1.—*Cases reported, fines imposed, and judgments recovered, fiscal year 1933*

Law involved	Number of cases	Fines and recoveries	Law involved	Number of cases	Fines and recoveries
National forest laws	54	$13,974.35	Federal Caustic Poison Act	5	$175.06
Food and Drugs Act	253	26,020.01	Produce Agency Act	12	815.00
Migratory Bird Treaty Act	220	7,416.14	Federal Seed Act	2	400.00
28-hour law	133	13,300.00	Upper Mississippi River Wild Life and Fish Refuge Act	5	60.00
Meat Inspection Act	21	1,056.00	Naval Stores Act	1	50.00
Plant Quarantine Act	7	255.00			
Animal quarantine acts	20	2,000.00			
Insecticide Act	19	1,130.00	Total	752	66,651.56

TABLE 2.—*Contracts and leases prepared or examined, fiscal year 1933*

Bureau, division, or office	Contracts	Leases	Total
Agricultural Adjustment Administration		1	1
Bureau of Agricultural Economics	9	54	63
Bureau of Agricultural Engineering	2	7	9
Bureau of Animal Industry	9	18	27
Bureau of Biological Survey	7	10	17
Bureau of Chemistry and Soils	5	3	8
Bureau of Dairy Industry	13	1	14
Bureau of Entomology	2	39	41
Bureau of Home Economics	2		2
Bureau of Plant Industry	15	31	46
Bureau of Plant Quarantine	8	29	37
Bureau of Public Roads	2	18	20
Crop Production and Seed Loan Office		3	3
Department library	3		3
Extension Work, Office of		2	2
Food and Drug Administration	14	2	16
Forest Service	1,288	12	1,300
Personnel and Business Administration	14	5	19
Weather Bureau	32	41	73
Total	1,425	276	1,701

In addition to the items listed in table 2, there were submitted, for examination as to sufficiency of form and execution, numerous contracts prepared by various bureaus and by individuals and corporations.

During the year 21 bonds covering Department employees, and 329 renewals and 43 terminations of leases and contracts were prepared. In addition to the examination of the above-tabulated contracts and the bonds connected therewith for sufficiency as to execution, there were examined for sufficiency of form and execution 1,002 cooperative agreements with State experiment stations and others covering experimental work of various kinds. There were also examined 23 bonds of indemnity covering advances under the Subsistence Expense Act of 1926, and the act of June 3, 1902. There were also prepared, and subsequently examined for sufficiency of execution, 1,042 bonds in connection with the administration of the Farmers' Seed Loan Act and the act approved January 22, 1932, creating the Reconstruction Finance Corporation, and the act, approved February 4, 1933, amending the same. In connection with these bonds, numerous letters were written to the surety companies involved in reply to their letters of inquiry relative to the status of the bonds resulting from a change of duties or

separation from the service of the principals thereunder. There were also examined 3,470 Federal highway-project contracts and 842 modifications thereof.

Five hundred and seven certifications of papers, records, and bulletins of the Department were prepared at the request of litigants for use as evidence by them in court proceedings.

Five claims of balances due estates of deceased employees were examined, necessary papers were prepared for their payment, and advice was given to administrative officials on matters pertaining thereto.

Many citizens of the several States have made inquiries of the Department concerning legal matters in which they were personally interested. While their subject matter, in numerous instances, did not fall within the scope of the activities of the Department, nevertheless in every case such information was furnished as was consistent with the Department's policy.

Forty claims involving damages to privately owned property, resulting from the alleged negligence of employees of the Department while engaged in the performance of their official duties, were considered and adjusted under the act of December 28, 1922.

Fourteen miscellaneous cases arising out of automobile accidents or covering claims for the recovery of money due the United States were referred to the Department of Justice. Of these cases and those previously referred to, seven were closed during the year. In the majority of the cases closed the Government was reimbursed for the damages suffered, or in the case of claims, collections were effected. In other instances, as a result of correspondence conducted by this office, payment of claims was secured without litigation.

Nineteen claims involving damages to privately owned property under contract of hire to the Forest Service were considered under the act of March 4, 1913, as amended by the act of January 31, 1931.

Eighteen employees of the Department, arrested while in the performance of their official duties for alleged violations of the traffic regulations, were represented at the hearings and trials by attorneys of this Office.

Three claims presented for consideration under the terms of the act of May 27, 1930, providing for reimbursement for damage to private property caused by employees of the United States in connection with the protection, administration, and improvement of national forests were also considered and adjusted.

This Office assisted in the preparation of administrative and fiscal regulations, orders, and memoranda of the Secretary, prepared and/or examined numerous Executive orders and proclamations. Also, assistance was given in preparation of legislation affecting the Department, particularly the Agricultural Adjustment Act.

Attorneys in the Office participated in, or attended, numerous hearings under the Packers and Stockyards Act of 1921, as well as hearings pertaining to the other activities of the Department. Many conferences were attended on matters relating to the plant quarantine, United States warehouse, standard container, perishable agricultural commodities, farm-products inspection, and national forest laws. Frequent conferences were held with attorneys and others interested in seizure and criminal cases pending in the Federal courts under the Food and Drugs Act and the Insecticide Act, and numerous conferences were also had with attorneys and others on legal matters in connection with the various other regulatory laws.

Regulations issued by the Secretary under the various statutes committed to the Department for administration were prepared, or assistance was given in their preparation. Among the more important of these were regulations governing the administration of the Perishable Agricultural Commodities Act and the enforcement of the Farm Products Inspection Law, the United States Warehouse Act, the United States Cotton Futures Act, the plant and animal quarantine laws, and the Seed Loan Act. Assistance was also given in the preparation of many amendments to regulations issued under the various regulatory laws. Many proclamations, forms, specifications, and schedules required in the enforcement of the regulatory laws were also prepared. Orders governing the interstate movement of plants and livestock, grain inspection, cotton standards, and the fiscal administration of the Department were also prepared, revised, or reviewed. Statements of issues, briefs, and memoranda on other legal matters were prepared at the request of the officials of the Department for submission to the Attorney General, the Secretary of the Interior, and the Comptroller General. Numerous service and regulatory announcements, circulars, and bulletins of the various bureaus, as well as contract forms prepared by the States for use in connection with Federal-aid road work were referred to this Office for consideration from a legal aspect and were reviewed and commented upon.

A great many bills for various purposes, referred to the Department for comment by committees of Congress, were examined, and assistance was rendered in the preparation of reports thereon. Among the bills so considered were the following: S. 5680, for the leasing of agricultural lands to reduce overproduction; S. 5613, providing for the granting of public lands to certain States, for the elimination of lands from national forests, and for other purposes; S. 5597, amending the Emergency Relief and Reconstruction Act of 1932 for highway construction; S. 5358, making the tariff effective on agricultural commodities domestically consumed; S. 5160, providing for loans to farmers during the year 1933; S. 1741, covering the use of public lands for grazing purposes; S. 783, prohibiting the counterfeiting of drugs; S. 598, providing for civilian conservation work; S. 507, making provision for farm relief; H.R. 1522, regulating the interstate shipment of cotton; H.R. 5755, for the encouragement of national industrial recovery; and H.R. 10743, covering the purchasing and use of domestic materials. A bill covering all the subject matter contained in the present Food and Drugs Act, and very materially extending the same, was also prepared during the fiscal year.

Briefs and memoranda on legal questions involved in many of the cases reported to the Attorney General for prosecution were prepared and furnished and assistance was also given the United States attorneys in the trial of some of the cases. Among the more important of these were: *Phillips* v. *Wood; United States* v. *First State Bank of Thompson Falls; United States* v. *Eastern Washington Timber Protection Association; United States* v. *Lake Hemet Water Co.; United States* v. *Surface Creek Ditch & Reservoir Co. and Grand Meca Resort Co.; United States* v. *Lillibridge; United States* v. *William Barton; United States* v. *Calvin Pell; United States* v. *Arizona Superintendent of Banks, Receiver of The Arizona Bank; United States* v. *Thomas Bowdon;* all arising in connection with the administration of the national forests; *United States* v. *M. E. Bogle,* under the Migratory Bird Treaty Act; *United States* v. *Powell et al.,* under the 28-hour law; and *Joseph S. Morgan, Irvin C. Morgan, partners doing business in the name of Morgan Packing Co.* v. *George R. Jeffrey, U. S. Attorney, and the Secretary of Agriculture; United States* v. *800 Sacks Barley and Mixed Oats; United States* v. *Certain Boxes of Tullibees; United States* v. *Shreveport Grain & Elevator Co.; United States* v. *Certain Bottles of B. & M.;* all arising under the Food and Drugs Act.

THE NATIONAL FORESTS

During the fiscal year there were handled 160 claims for lands within the national forests which were initiated under the public-land laws of the United States. Decisions were rendered on 58 of these claims, of which 50 were favorable to the Government and 8 were unfavorable.

Attorneys of this Office participated in the trials of 28 court cases and represented the Government before the United States local land offices in 19 hearings. There were handled also 223 trespass cases involving property of the United States on national forests.

Oral advice was frequently given, and numerous written opinions relating to the administration of the national forests were submitted. There were prepared or passed upon for legal sufficiency 1,675 legal papers of various kinds.

Work for the Forest Service during the fiscal year, other than under the Weeks Forestry Law, included handling the following cases and other business:

Claims to lands pending during year	160
Hearings attended	19
Briefs prepared and filed	32
General litigation and settlement	77
Contracts, leases, bonds, etc	1,266
Bills, complaints, informations, protests, etc	87
Abstracts of title examined	303
Court appearances	28
Written opinions	287
Stipulations	17
Trespasses:	
Grazing	29
Timber	27
Fire	32
Property	33
Occupancy	19
Miscellaneous	33
Cases under State laws	61

The amount of damages sustained and the fines imposed in 54 cases are shown in table 3.

TABLE 3.—*Trespass cases on the national forests in which damages and fines were recovered, fiscal year 1933*

Character of trespass	Number	Amount of damage	Fines imposed
Grazing	12	$4,379.24	
Timber	18	6,915.34	$100
Fire	19	1,990.48	137
Property	2	100.53	50
Occupancy			
Miscellaneous	3	266.66	35
Total	54	13,652.25	322

CASES OF INTEREST

The case of *United States* v. *Threlkeld* arises in connection with the attempt of the Forest Service, under regulation 35-S of the National Forest Manual of Regulations and Instructions, to secure by condemnation a right of way for a lumber company purchasing timber on the national forest. The company in this case—the purchaser of timber on the Lincoln National Forest—sought to condemn a right of way over the lands of one George Threlkeld. The company prevailed in the lower court; but on appeal to the Supreme Court of New Mexico, it was held that a lumber company in New Mexico does not have the power to condemn a right of way for a logging railroad. A petition is being prepared for the purpose of having the United States condemn the right of way for this purpose. The Forest Service contemplates, after the timber purchased by the company has been removed, to use the logging-railroad grade as a location for a forest-development road.

The case of *United States* v. *William Baker* involved the attempt of locators to get, for residence and business purposes, title to land along a transcontinental highway in the Prescott National Forest, under the guise of the mining laws. No commercial ore had been reached, but practical mining men testifying for the locator emphasized the leaching from the surface as ground for the belief that valuable ore would be found below the oxidized zone. The Secretary of the Interior decided against the entry, however, supporting the findings of the Commissioner of the General Land Office that leaching has little significance in the case of relatively insoluble metals, such as gold and lead; that the evidence of copper and silver was too slight to be considered; that the values in gold are such as may be found in any country rock in a mineral district; that higher degree of proof of discovery is required when the applicant applies for a patent than would be required simply to sustain the location as against a relocator; and, furthermore, that the Department was not satisfied that the claim was held for bona fide mining purposes. This case is typical of approximately 25 other cases on this forest, and the decision against this entry will probably discourage the development of the others.

The case of *United States* v. *Strumquist* involved a mineral location along United States Highway No. 470, about 15 miles from Albuquerque, N.Mex., in the Sandia Mountains within the Cibola National Forest. The Commissioner of the General Land Office, on February 15, 1933, held the entry for cancelation upon the evidence that there was as yet no quarry from which a commercial dimension stone could be produced, and it appeared that the land was more valuable for residential purposes than for mineral.

In a grazing trespass case against the Three Bar Ranch Co. (Fred H. Bixby), of the $2,786.09 collected by the Government as damages, $620.92 represented forest officers' time and expenses in accordance with regulation T-13. The inclusion of such items in the measure of the Government's damages represents a victory of considerable importance for which the Forest Service has persistently contended, sometimes unsuccessfully. Substantial amounts were also recovered in two other cases.

An interesting situation arose involving a possible conflict between State and Federal jurisdiction on the national forests in connection with the use of dynamite by forest officers on the national forests in Arizona. The sticks of dynamite did not bear the date of manufacture, which is required by Arizona law, and the State mine inspector of Arizona, upon discovering this, warned the several forest

supervisors not to use it. The attorney general of the State at first gave an opinion that the Government was not subject to the provisions of the State law, but later reversed himself. In the meantime the various officers had used practically all the dynamite.

The case of *United States* v. *E. C. Lillibridge et al.* involved the location of mining claims on special-use summer-home areas in the Arrowhead Lake district, San Bernadino Forest. The locators alleged that valuable feldspar deposits existed within the claims and by blasting and excavating annoyed the summer-home residents whose interests were valued at $250,000. A restraining order and temporary injunction were first secured, and after final hearing the court rendered its decision holding that the validity of mining locations within a national forest—

is to be determined by a comparison of the relative value of the lands in question for forest or mineral purposes. * * * and although a discovery is made, the showing must reveal the probability of a mineral deposit of commercial value * * * Under the evidence the land has been set apart and reserved for forest usage and is nonmineral * * *.

The court further said:

The permits for summer homes, public camp grounds, resorts, and other recreational sites, issued under the act of June 4, 1897, and the act of March 4, 1915, upon the special-use areas, being prior in time, take precedence over the subsequent mining locations and said mining locations are invalid.

WEEKS FORESTRY LAW

(36 Stat. 961)

The legal work involved in the acquisition of lands under the Weeks Forestry Law and under the Clarke-McNary Act, approved June 7, 1924 (43 Stat. 653), as amended, has progressed satisfactorily during the year, but the acquisitions thereunder, due to a substantial reduction in the annual appropriation for the purposes of the acts, have not been as numerous as in former years. There was, during the first 10 months of the year, a relative reduction in the field and office force engaged in this work.

The National Forest Reservation Commission held three meetings during the year but authorized no additional acquisitions until the meetings of June 9 and June 20, 1933, when the acquisition of 485 tracts, totaling 667,314 acres, was approved. Purchases under these authorizations are to be made from an allotment from the appropriation Emergency Conservation Fund (War Transfer to Agriculture, act of Mar. 31, 1933).

There were closed during the year 473 acquisitions, aggregating 161,585.73 acres, at a total cost of $682,311.22.

There were pending in the United States district courts 179 condemnation suits involving the acquisition of 58,114 acres and 137 cases aggregating 129,824 acres, which had been examined and approved for purchase and which are awaiting institution of condemnation proceedings to effect their acquisition.

FOOD AND DRUGS ACT

(34 Stat. 768)

At the beginning of the fiscal year there were pending in the courts 445 cases under the Federal Food and Drugs Act, of which 151 were criminal and 294 were civil. During the year there were reported to the Department of Justice 399 criminal cases, involving 920 violations, and 1,828 civil cases, a total of 2,227 cases in all. There were thus pending during the year 550 criminal and 2,122 civil cases, making a total of 2,672 cases in all. There were terminated during the year 296 criminal and 1,729 civil cases, a total of 2,025, leaving 254 criminal and 393 civil cases, or a total of 647 cases pending at the close of the fiscal year.

The 296 criminal cases disposed of were terminated as follows: 214 upon pleas of guilty, 36 on pleas of nolo contendere, 3 after jury trials in which verdicts were returned in favor of the Government, and fines were imposed as shown in table 4; 26 cases were nolle prossed or dismissed; in 4 cases verdicts were returned finding the defendants not guilty; 2 cases were dismissed by the court after pleas of guilty had been entered; jail sentences were suspended in 2 cases, after pleas of guilty, and the imposition of sentences was suspended in 2 cases after a like plea; 1 case was stricken from the docket with leave, 1 was placed in permanent abeyance, and 5 were submitted to grand juries in which no bills were returned.

TABLE 4.—*Fines imposed in criminal cases (exclusive of costs, which were generally assessed) under the Food and Drugs Act, fiscal year 1933*

Number of cases	Amount of fine	Total	Number of cases	Amount of fine	Total
1	$0.01	$0.01	1	$125.00	$125.00
4	1.00	4.00	9	150.00	1,350.00
1	2.00	2.00	1	170.00	170.00
1	3.00	3.00	2	175.00	350.00
1	4.00	4.00	20	200.00	4,000.00
13	5.00	65.00	3	300.00	900.00
22	10.00	220.00	1	325.00	325.00
1	12.00	12.00	1	330.00	330.00
3	20.00	60.00	3	400.00	1,200.00
60	25.00	1,375.00	1	425.00	425.00
1	30.00	30.00	2	500.00	1,000.00
1	40.00	40.00	5	600.00	3,000.00
60	50.00	3,000.00	2	800.00	1,600.00
8	75.00	600.00	1	1,200.00	1,200.00
26	100.00	2,600.00	1	1,800.00	1,800.00
1	110.00	110.00			
1	120.00	120.00	Total 253 cases		26,020.01

Of the 1,729 civil cases terminated, 967 were terminated by default decrees, 597 by consent decrees, 6 after jury trials in which verdicts were returned in favor of the Government, 2 after jury trials in which verdicts were returned in favor of the claimant, and 157 were dismissed chiefly because no seizure of the goods had been effected. Twelve hundred and nineteen notices of judgments were prepared and published during the year.

The case of *United States* v. *Loose-Wiles Biscuit Co.* was based on a criminal information containing 6 counts, 3 of which charged the defendant with the interstate shipment of adulterated strawberry-cream sandwich, and the other 3 counts charged the interstate shipment of misbranded strawberry-cream sandwich.

The misbranding counts charged that said article of food, when shipped and delivered for shipment, was then and there misbranded, in that the statement, to wit, "Strawberry Cream Sandwich", borne on the cartons and packages was false and misleading in this, that it represented that said article consisted of a strawberry-cream product; whereas, in truth and in fact, said article did not so consist, but did consist of an artificially colored and an artificially flavored product which contained no strawberry; that said article was further misbranded in that it was labeled as aforesaid so as to deceive and mislead the purchaser into the belief that it consisted of a strawberry-cream product, whereas, in truth and in fact, said article did not so consist, but did consist of an artificially colored and an artificially flavored product which contained no strawberry; and that said article was further misbranded in that it was an artificially colored and an artificially flavored product which contained no strawberry, prepared in imitation of strawberry-cream sandwich, and was offered for sale and sold under the distinctive name of another article, to wit, "Strawberry Cream Sandwich."

At the trial in the District Court for the Eastern District of New York, the jurisdictional facts having been stipulated, it was proved that the sandwich in question did not contain strawberry, but did consist of an artificially colored and an artificially flavored product. At the close of the evidence the court withdrew the counts charging adulteration and submitted the case upon the three counts charging misbranding. The jury returned a verdict finding the defendant guilty on all three counts, and the court imposed a fine on the defendant of $200 on each of the three misbranding counts.

The case of *United States* v. *Leo Banks Barlett*, was a criminal proceeding instituted by information containing one count, charging shipment by defendant of a drug under the name "Banbar." The information charged the defendant with the shipment in interstate commerce of a bottle containing an article designed and intended to be used in the cure, prevention, and mitigation of diseases of man, that is to say, a certain article of drugs, bearing statements, designs, and devices regarding its therapeutic and curative effects, and labeled, marked, and branded on the bottle "For the Diabetic (Diabetes-Mellitus)", and that said article when shipped was misbranded within the meaning of the Food and Drugs Act, as amended, in that the statements, designs, and devices regarding the therapeutic and curative effects thereof appearing on the label of the bottle were false and

fraudulent, in that the same were applied to said article knowingly, and in reckless and wanton disregard of their truth or falsity, so as to represent falsely and fraudulently to purchasers thereof, and create in the minds of purchasers thereof, the impression and belief that the article was, in whole or in part, composed of, or contained ingredients or medicinal agents effective as a treatment for the diabetic, when in truth and in fact, said article was not in whole or in part, composed of, and did not contain, ingredients or medicinal agents effective as a treatment for the diabetic.

At the trial of the case in the District Court for the Western district of Pennsylvania at Pittsburgh, the Government offered a number of expert medical men, some being recognized as America's most eminent diabetic specialists, who testified to the inefficacy and utter worthlessness of Banbar as a diabetic remedy. The Government also introduced a number of lay witnesses who testified to the use of Banbar with no beneficial results whatever. The defendant introduced one local doctor and a number of lay witnesses who testified to the use of Banbar with apparent or seeming beneficial results in most cases. Upon submission of all the evidence, and after the court's charge to the jury, the jury returned a verdict finding the defendant not guilty.

The case of *United States* v. *Trout Brook Creamery Co.* was instituted by the filing of an information charging the defendant with the interstate shipment of adulterated butter, in that it contained less than 80 percent by weight of milk fat as defined and required by the act of March 4, 1923 (42 Stat. 1500). The case was tried in the district court at Montpelier, Vt. The analyst for the Government testified that the butterfat content of the product in question was only 77.10 percent. The evidence of the defendant was to the effect that the company believed the butter to contain not less than 80 percent milk fat. The jury, after being instructed by the court, returned a verdict finding the defendant not guilty.

The case of the *United States* v. *Eatmor Chocolate Co.* was a criminal action. The information contained two counts. The first count charged the defendant with the interstate shipment of an article of food invoiced as "Golden Milk Chocolate Coating", and that it was adulterated, in that it had been prepared with skim milk instead of with whole milk, which the article purported to be. The second count was based upon the same shipment as the first and charged misbranding of the article of food, in that it was a product containing skim milk prepared in imitation of a product containing whole milk and that it was offered for sale and sold under the distinctive name of another article. At the trial in the District Court for the Western District of Pennsylvania, the jurisdictional facts having been stipulated, the case was tried to a jury. The testimony of the analyst on behalf of the Government was that the chocolate in question had been prepared from skim milk, and that whole milk had not been used in preparing the product. The testimony of the defendant tended to show that it had been prepared from whole milk. At the conclusion of the trial, the jury, after receiving the instructions of the court, returned a verdict finding the defendant guilty on both counts of the information, and the court imposed a fine of $100 and costs on each of the two counts involved.

In the case of *United States* v. *11 Dozen Cartons of Vapex*, tried in the United States District Court for the District of Maryland, the court sustained the Government's demurrer to a special plea of the claimant contending (1) that Vapex is not a drug within the meaning of the Food and Drugs Act; (2) that the Food and Drugs Act, if construed in accordance with the legislative intent, does not apply to an article of this nature; and (3) that, if construed to apply to an article such as Vapex, the provision of the Food and Drugs Act requiring the declaration of alcohol on the label of an article such as Vapex is unconstitutional, in that Congress has no power under the commerce clause of the Constitution to exclude such an article from interstate commerce or to require the declaration of alcohol on the label, in the absence of a showing that the alcohol renders the article noxious or harmful to the public health. The claimant elected to stand on its special plea and permitted judgment to be entered from which it took an appeal to the Circuit Court of Appeals for the Fourth Circuit. Subsequently, this appeal was dismissed by agreement of the parties and the judgment of the district court became final.

The case of *United States* v. *800 Sacks of Barley Mixed Oats, E. E. Anderson, Intervenor*, was an appeal from the District Court for the Southern District of Mississippi wherein certain errors were assigned to the district court's charge to the jury.

The libel charged that the oats were adulterated by virtue of the addition of approximately 4 percent of water. The court charged the jury that, under no circumstances, would the addition of 4 percent of water constitute a substitution within the meaning of paragraph 2, article 7, of the Food and Drugs Act. The court further charged the jury that if the added moisture only increased the weight of the grain, without otherwise affecting its nutritional value, it could not be held that the substance had been mixed and packed with the oats so as to reduce, lower, or injuriously affect their quality or strength, within the meaning of paragraph 1 of section 7 of the act. In affirming the judgment of the district court, the Circuit Court of Appeals for the Fifth Circuit commented upon the district court's charge to the jury as follows:

> We agree with the District Judge that there was no substitution of moisture for grain. There is more or less moisture in ripe grain, depending upon locality, season of the year, and atmospheric conditions. Nor is it seriously contended that the percentage of moisture in the grain, which was less than that authorized by the Department of Agriculture under the Grain Standards Act, was deleterious or in any way injurious to the health of the animals. The real insistence is that the purchaser of grain by weight would be paying a part of the purchase price for water. Two cases are relied on by the appellant in support of this position. The first is *Union Dairy Co.* v. *United States*, 250 F. 231, in which it was held that the addition of water to milk constitutes adulteration. That case is easily distinguishable from this. Water injuriously affects the quality and strength of milk and renders it less palatable and less nutritious. But a mixture of barley and oats which contains an excess of 4 per cent above the average of moisture is not injured thereby or made less valuable or desirable as a food for animals. The other case, *United States* v. *154 Sacks of Oats*, 283 F. 985, is not in point here because there the addition of wild oats, seeds of weeds, chaff, and dust to the grain afforded indubitable evidence both of substitution and of adulteration.

This Department recommended to the Attorney General that a petition for certiorari be filed with the Supreme Court seeking a review of the judgment on the ground of the public importance of the question and on the further ground that the decision of the Circuit Court of Appeals was in conflict with the decision of the Circuit Court of Appeals for the Seventh Circuit in the case of *Union Dairy Co.* v. *United States* (250 F. 231), but the Attorney General, upon consideration of the matter, advised this Department that it had been determined that application for certiorari would not be filed.

In the case of *United States* v. *469 Cases of Tomato Paste*, tried in the eastern district of Louisiana, the libel charged that the tomato paste in question was adulterated, in that an insufficiently concentrated strained tomato product had been substituted for tomato paste. It further charged that the article was misbranded, in that the name "tomato paste" applied to such an article was false and misleading and that the product was offered for sale under the distinctive name of another article. The evidence showed that on April 28, 1932, this Department had, for the first time, promulgated a standard for tomato paste, providing that such an article should contain not less than 22 percent of tomato solids. The shipments in question had been made during the month of July 1931, several months before this standard was promulgated. The standard, therefore, served no part in determining the issues of adulteration and misbranding and it was necessary to establish those issues by a showing that the trade-and-consumer understanding is that tomato paste is an article sufficiently concentrated as not to pour out of the can. The tomato paste in question contained approximately 11 percent of tomato solids, giving it a very light consistency easily capable of being poured from the can.

The evidence adduced on behalf of claimant showed that, in the vicinity of New Orleans, there is a trade-and-consumer understanding as to the composition of tomato paste which affords considerable latitude. A number of trade witnesses testified that they regarded tomato products of heavy consistency and those of light consistency, such as that on trial, alike, and recognized both under the name of tomato paste and that such was the consumer understanding in and about New Orleans.

The court charged the jury that the Government standard promulgated several months after the article in question had been shipped, should not be taken into consideration, but that the issues should be determined entirely from the trade and consumer understanding as shown by the evidence. Under this instruction the jury returned a verdict for the claimant. The case is illustrative of the difficulty that is frequently encountered in attempting to prove adulteration and misbranding on the basis of a standard which exists only in the minds of the trade and consuming public.

The case of *United States* v. *Certain Boxes of Tullibees*, tried in New York City, was a proceeding to condemn and forfeit a large quantity of fish previously taken from Lake Winnipeg. The libel charged that the fish were adulterated in that they consisted in whole or in part of filthy, putrid, and decomposed animal substance. The Government proved that about three fourths of the fish were

infested with parasites, averaging about three or four parasites per fish. Each of these parasites was a threadlike worm, several nches in length, the longer ones being approximately 1 foot long. This worm is of a very rudimentary nature and lies in a cyst embedded in the muscles of the fish. Surrounding the worm in the cyst is a thick fluid, in appearance not unlike pus. The cysts are from one fourth to one half inch in one diameter and perhaps a little bit longer in another diameter. The parasite is a larval stage of a tapeworm found in the intestines of pickerel.

There was no evidence that the cysts, liquid, or parasites in the muscles of the tullibees are at all injurious to the health of either the fish or any human being eating them. Neither was there any evidence that the presence of the parasite with the cyst and exudate in any way affected the flavor of the fish. The objectionable character lay only in the fact that, if discovered, they would revolt the imagination of the eater; in other words, the objection to them is solely upon aesthetic grounds. The claimant showed that after cooking these worms became congealed and could not be distinguished from the flesh of the fish, and contended that, in view of the fact that the only objection to the worm was an aesthetic one, that objection was wholly removed after the fish were cooked.

The case was tried before a jury of one, resulting in a verdict for the Government, the court holding that the purpose of the provision of the Food and Drugs Act condemning filth in food was particularly directed at filth which could not be seen, since the consumer would not need the protection of the law where the filth was apparent. Judgment was entered accordingly, from which no appeal was taken.

The case of *United States* v. *Shreveport Grain & Elevator Co.* (287 U.S. 77) was an appeal, pursuant to section 682 of the Criminal Code (title 18, sec., 682, U.S.C.), from the judgment of the District Court for the Western District of Louisiana, charging the defendant with having shipped certain misbranded sacks of ground meal from the State of Louisiana into the State of Texas. Section 8, paragraph 3 of the Food and Drugs Act, as amended by the act of March 3, 1913 (title 21, sec. 10, U.S.C.), provides that an article of food shall be deemed to be misbranded,

If in package form, the quantity of the contents be not plainly and conspicuously marked on the outside of the package in terms of weight, measure, or numerical count: *Provided, however,* That reasonable variations shall be permitted, and tolerances and also exemptions as to small packages shall be established by rules and regulations made in accordance with the provisions of Section three of this act.

The indictment charged that the net-weight markings on the outside of the sacks of ground meal stated a quantity greater than was actually contained in the sacks. The defendant demurred to the indictment on the ground that it charged no offense against the United States. The defendant also filed a motion to quash on the ground that paragraph 3 of section 8 of the act is unconstitutional under articles I, II, and III, and amendments V and VI of the Constitution. The district court sustained the motion to quash on the ground that paragraph 3 of section 8 of the act is too loose and indefinite to constitute a valid definition of a crime, in that it sets up no ascertainable standard of guilt and is, therefore, violative of the sixth amendment. The Supreme Court, in an opinion by Mr. Justice Sutherland, held that section 3 of the act, as amended, does not delegate legislative power, but confers administrative authority on the Secretaries of Treasury, Agriculture, and Commerce, to make rules and regulations permitting reasonable variations from the hard and fast rules of the act, and that the regulations made pursuant to this authority are sufficiently definite to fulfill the requirements of amendment VI of the Constitution.

The case of *United States* v. *Certain Bottles of B & M* was on trial on the merits in the United States District Court for the District of Maryland at the beginning of the fiscal year. This case is regarded as one of the most important cases instituted under the Food and Drugs Act during the last decade.

The preparation B & M is an external remedy and was represented by statements on its cartons and bottle labels, and in a booklet contained within each of the cartons, as having curative and therapeutic value in tuberculosis, pneumonia, influenza, bronchitis, laryngitis, pleurisy, rheumatic fever, rheumatism, lumbago, whooping cough, and other diseases. Further than this, the booklet contained statements representing the preparation as having penetrative powers, so that, when applied to the skin, it would exert antiseptic action within the human body.

The libel charged (1) that the article B & M was adulterated, in violation of section 7 of the Food and Drugs Act, paragraph 2, in the case of drugs, in that it is sold under its own standard of strength, namely, as an antiseptic, when in truth and in fact it falls below such professed standard of strength, for the reason that it is not antiseptic when used as directed; (2) that the article B & M in

question is misbranded, in violation of the general paragraph of section 8 of the Food and Drugs Act, in that the statements "an antiseptic" and "for antiseptic applications," together with several pages of printed matter elaborating upon the antiseptic action of the drug, all of which statements appear in the booklet enclosed within the package, are false and misleading, in that the statements represent the article as being antiseptic when used as directed, when, in truth and in fact, it is not so antiseptic; and (3) that the article B & M in question is misbranded, in violation of section 8, paragraph 3 of the Food and Drugs Act, as amended, in that certain statements borne on the carton, bottle label, and in the booklet contained within the carton, concerning the curative and therapeutic effect of the article, are false and fraudulent.

Before joining issue on the merits, the claimant brought exceptions to the libel contending (1) that the word "antiseptic," appearing upon the labeling or literature of a proprietary remedy, does not profess a standard of strength under which the article is sold within the meaning of section 7 of the Food and Drugs Act; (2) that section 7 of the act deals with a professed standard of strength only when such standard appears on the outside of the package and does not, therefore, apply to statements appearing in a booklet contained within the package, such as the libel refers to under its adulteration charge; (3) that the general paragraph of section 8, defining one phase of misbranding, applies only to statements appearing on the outside of the package and has no application to statements appearing within the package; (4) that the general paragraph, under section 8, is confined to statements concerning the identity of the article only and does not apply to statements concerning strength, quality, or purity of the article; and (5) that the allegation in the libel charging the preparation B & M to be misbranded in violation of section 8, paragraph 3 of the act,

> in that certain statements * * * regarding the curative and therapeutic effect of the said article are false and fraudulent in this that the article contains no ingredient or combination of ingredients capable of producing the effects claimed, and that the same were applied to the said article knowingly or in reckless and wanton disregard of their truth or falsity,

does not state a violation of section 8, paragraph 3, for the reason that this paragraph applies only to statements made with actual knowledge of their falsity and with an actual intent to deceive, and that it has no application to false statements which are made in reckless and wanton disregard of the truth.

In dealing with these respective contentions, the court held (1) that the word "antiseptic" appearing upon the labeling or literature of a proprietary remedy is not a profession of the standard of strength within the meaning of section 7 of the Food and Drugs Act and hence the allegations in paragraph 2 of the libel failed to show that the preparation B & M was adulterated; (2) that the definition of misbranding contained in the general paragraph of section 8 of the act embraces statements concerning the strength, quality, or purity of an article as well as statements concerning its identity, but that this paragraph dealt with statements appearing on the outside of the package only, hence it had no application to the statements referred to in paragraph 3 of the libel, since they were all statements appearing in a booklet contained within the B & M carton; and (3) that false statements concerning the curative and therapeutic effect of a drug made with reckless or wanton disregard of their truth or falsity are as much a violation of section 8, paragraph 3 of the act, as are such false statements made with full knowledge of their falsity and with an actual intent to deceive, hence the charge of misbranding contained in paragraph 4 of the libel is good and sufficient.

The case came on for trial on the merits on June 27, 1932. After an extensive preparation, the Government summoned to Baltimore an array of expert witnesses in the fields of chemistry, pharmacology, biochemistry, and internal medicine. Among the latter were some of the most eminent physicians in North America, several of whom have devoted their lives to the study and treatment of tuberculosis. These witnesses testified as experts that the preparation was worthless for any of the diseases mentioned above and that this is in accord with the general agreement of medical opinion. The claimant produced one practicing physician who professed to have used the preparation in many cases and over a wide range of diseases and conditions with highly satisfactory results. It developed that this doctor was the paid medical adviser of the claimant company. A large number of lay witnesses also testified on behalf of the claimant, many of whom testified to having been cured of tuberculosis by the use of B & M. All but one of these latter witnesses were submitted to physical examination after leaving the witness stand and all so examined were found to be still tubercular. The one witness not examined refused to submit to examination. After a trial which lasted more than 3 weeks the jury returned a verdict in favor of the Government and judgment was entered accordingly, from which no appeal was taken.

THE INSECTICIDE ACT

(36 Stat. 331)

Thirty-nine cases were reported to the Attorney General during the fiscal year, in 20 of which criminal proceedings were recommended. The remaining 19 cases reported were civil or seizure cases, brought against products alleged to be adulterated or misbranded. At the beginning of the year, 16 cases were pending, 9 of which were criminal and 7 civil or seizure cases.

In the 29 criminal cases, either pending at the beginning or reported during the year, pleas of guilty were entered in 19, leaving 10 criminal cases pending.

Of the 26 civil, or seizure, cases, either pending at the beginning or reported during the year, 12 were terminated by the entry of default decrees of condemnation and destruction, 3 by consent decrees of condemnation followed by the taking of the goods down under bond for reconditioning or relabeling, and 2 were dropped for the reason that the goods had been disposed of before seizure could be effected, leaving 9 civil, or seizure, cases pending.

The fines imposed in the criminal cases referred to above consisted of $250 in each of 2 cases, $75 in 1 case, $50 in each of 8 cases, $25 in each of 4 cases, $20 in each of 2 cases, $10 in 1 case, and $5 in 1 case, the total of the fines being $1,130.

Thirty-five notices of judgment were prepared and published under section 4 of the act.

MEAT INSPECTION ACT

(34 Stat. 1260)

Thirty-nine cases were reported to the Attorney General for prosecution under the Meat Inspection Act during the fiscal year. Fourteen cases, including 1 case instituted under the Horse-meat Act, were pending at the beginning of the year. Of these, convictions were secured in 25 cases, resulting in the assessment of fines as shown in table 5. In 3 cases the defendant was given a short jail sentence or was required to remain in the custody of the United States marshal; in 1 case sentence was suspended without costs; in 4 cases the grand juries refused to return indictments. Six cases reported during the previous year and 18 reported during this fiscal year were still pending at the close of the fiscal year.

TABLE 5.—*Fines imposed in meat-inspection cases, fiscal year 1933*

Number of cases	Fine in each	Total fines	Number of cases	Fine in each	Total fines
1	$225	$225	8	$25	$200
2	100	200	1	1	1
8	50	400			
1	30	30	Total (21 cases)		1,056

VIRUS SERUM TOXIN ACT

(37 Stat. 832)

Advice was given to administrative officers on various legal questions arising in connection with the enforcement of the Virus Serum Toxin Act.

NAVAL STORES ACT

(42 Stat. 1430)

There was pending at the beginning of the fiscal year, under the Naval Stores Act, one criminal case. This case was terminated by a plea of nolo contendere and the imposition of a fine of $50. No cases were instituted during the year.

Opinions, both formal and informal, upon various legal matters arising in the administration of this statute, were rendered to administrative officials.

FEDERAL SEED ACT

(37 Stat. 506)

At the beginning of the fiscal year there were 6 criminal and 2 seizure cases pending under the Federal Seed Act. During the year there were reported to the Attorney General 12 criminal and 19 seizure cases. Three of the criminal

cases were terminated—2 on pleas of nolo contendere with fines imposed of $200 in each case, and 1 on a verdict of not guilty. Four of the seizure cases were terminated—2 by consent decrees and 2 by default decrees. There were thus pending at the close of the fiscal year 15 criminal and 17 seizure cases.

FEDERAL CAUSTIC POISON ACT

(44 Stat. 1406)

At the beginning of the fiscal year there were 2 seizure and no criminal cases pending under the Federal Caustic Poison Act. During the year there were reported to the Attorney General 5 seizure and 7 criminal cases. Five of the seizure cases were terminated by default decrees, and 5 of the criminal cases were disposed of by pleas of guilty, in which a fine of $50 each was assessed in 3 cases, a fine of $25 in 1 case and a fine of 6 cents in the other case. There were thus pending at the close of the fiscal year 2 seizure and 2 criminal cases.

Nine notices of judgment were prepared and published during the year.

PLANT QUARANTINE ACT

(37 Stat. 315)

Prosecutions were instituted under the Plant Quarantine Act in 9 cases during the year, either through the Attorney General or by United States attorneys, on information furnished by the Departments. Of these, 5 were closed by the imposition of fines, 1 by suspension of sentence, and 2 by dismissal. At the close of the fiscal year 1932, there were 4 cases pending, 2 of which were closed during this year by the imposition of a fine, and 1 was dismissed. Table 6 shows the fines imposed in 7 cases.

TABLE 6.—*Fines imposed in plant quarantine cases, fiscal year 1933*

Number of cases	Amount of fine	Total	Number of cases	Amount of fine	Total
2	$10	$20	1	$100	$100
1	20	20			
1	25	25	Total (7 cases)		265
2	50	100			

Ten written opinions were given on legal questions raised by the Bureau of Plant Quarantine, and many informal opinions were given in conference with representatives of the Bureau. Conferences were also had with reference to the revision of quarantines or of regulations supplemental thereto as follows: The lifting of the European corn-borer quarantine (no. 43) and of the phony peach-disease quarantine (no. 67); the date palm scale-insect quarantine (no. 6) and its regulations, revised; Japanese-beetle quarantine (no. 48) and regulations, revised twice, and its regulations separately revised twice; seed or paddy rice quarantine (no. 55) and its regulations, revised; white pine blister rust quarantine (no. 63) revised; regulations of the fruit and vegetable quarantine (no. 56) revised twice; assisted in the preparation of the new packing-materials quarantine (no. 69) and its regulations and in the later revision of its regulations.

FEDERAL HIGHWAY ACT

(42 Stat. 212)

During the fiscal year, 846 original and 68 revised project statements for Federal-aid road projects approved by the Department were first reviewed to determine whether they were eligible under the law. The amount of Federal funds which these projects will involve is not yet determined, as the Federal aid is allocated only as project agreements are entered into for the construction of projects or individual sections thereof.

During the fiscal year, 2,623 original project agreements and certificates of approval of plans, specifications, and estimates prepared by the Bureau of Public Roads were reviewed as to their form and sufficiency of execution by the State highway departments and were submitted to the Secretary and executed by him. Drafts of 658 modifications of project agreements and certificates of

approval, prepared by the Bureau of Public Roads for execution by the State highway departments and the Secretary, were similarly reviewed. These original and modified project agreements involved work estimated to cost $234,520,596.15 and Federal aid in the amount of $81,734,519.65. They involved also the improvement with Federal funds of 15,802.4 miles of road. In addition to the foregoing, project substitutions to the number of 18 were reviewed during the fiscal year and approved by the Secretary.

There also were 166 cooperative agreements between the Department and the cooperating agency for constructing roads within or partly within the national forests, and 135 original construction contracts were entered into after advertisement and award for the construction of such roads. All of these cooperative agreements and construction contracts were reviewed as to form, substance, and sufficiency of execution.

There also were 19 original and 1 revised project statement for flood-relief projects reviewed as to legal eligibility of the proposed improvement and recommended for approval by the Secretary of Agriculture. In addition, there were 24 original and 8 modified project agreements for flood-relief projects during the fiscal year which involved 118.6 miles of road and $542,253.38 as the Federal share of the cost of their construction.

There were examined for approval by the Department 14 original and 2 revised project statements for Federal-land highway projects under the act of June 24, 1930 (46 Stat. 805). There also were 23 original and 14 modified project agreements for Federal-land highway projects, which were reviewed and recommended for approval by the Secretary of Agriculture. These Federal-land highway project agreements involved 108.1 miles of road and $1,218,728.55 as the Federal share of the estimated cost of their construction.

During the year, two written opinions were given upon questions involving the interpretation of the Federal Highway Act, and a great many informal opinions were given in conferences with representatives of the Bureau with reference to this act and in connection with the preparation and issuance by the Bureau of new and amended regulations under this act, as well as regulations issued pursuant to the Industrial Recovery Act of June 16, 1933, which provided $400,000,000 for emergency construction of public highways, etc., in accordance with the procedure set up by the Federal Highway Act.

ACTS RELATING TO THE INTERSTATE MOVEMENT OF LIVESTOCK FROM QUARANTINED DISTRICTS, PROHIBITING THE INTERSTATE MOVEMENT OF DISEASED LIVESTOCK

(23 Stat. 31; 26 Stat. 414; 32 Stat. 791; 33 Stat. 1264)

Eight cases were reported to the Attorney General for prosecution under the act of May 29, 1884 (23 Stat. 31), of which 1 was terminated by a fine of $100, and 1 by dismissal. Of the cases pending at the close of the preceding fiscal year, 3 were terminated by dismissal, 1 by the entry of an order of nolle prosequi and 1 by the refusal of the grand jury to indict. There were 13 cases pending at the close of the fiscal year.

Nineteen cases were reported to the Attorney General for prosecution under the act of February 2, 1903 (32 Stat. 791), of which 6 were terminated by fines of $100 and 2 by dismissal. Of the cases pending at the close of the preceding fiscal year, 13 were terminated by fines of $100 each, and 1 by the refusal of the grand jury to indict. There were 27 cases pending at the close of the year.

No cases were reported to the Attorney General for prosecution under the act of March 3, 1905 (33 Stat. 1264). One case, pending at the beginning of the fiscal year, was still pending at the close thereof.

In all, 27 cases under the animal quarantine laws were reported to the Attorney General during the year, and 41 cases were pending at the close thereof. In the enforcement of these laws 20 cases were disposed of by the imposition of a fine of $100 in each case.

One case, based on an alleged violation of section 306 of the Tariff Act of 1930 (46 Stat. 590, 689), in importing cattle from a foot-and-mouth disease infected foreign country into the United States was reported to the Secretary of the Treasury but was dropped without prosecution.

Two cases involving assaults on employees of the Bureau of Animal Industry, in violation of title 18, section 118, United States Code, were reported to the Attorney General for prosecution. One case was terminated by sentence of the defendant to imprisonment for 18 months; the other was still pending at the close of the year.

Ten bonds to insure the handling, in accordance with the regulations of this Department, of hides, skins, etc., imported from foreign countries were examined during the year.

TWENTY-EIGHT-HOUR LAW

(34 Stat. 607)

One hundred and forty cases were reported to the Attorney General under the 28-hour law.

Penalties aggregating $13,300 were recovered in 133 cases. Twenty cases were dismissed, and in one judgment was rendered for the defendant. In another, judgment rendered for the defendant was reversed by the Circuit Court of Appeals for the Fourth Circuit.

One hundred and seventy-eight cases were pending at the close of the year.

An important decision was given June 15 in the United States Circuit Court of Appeals for the Fourth Circuit at Richmond, Va., in the 28-hour law case against the receivers of the Seaboard Air Line Railway Co. The offense charged in the action brought in the United States District Court for the Eastern District of Virginia was that the defendant, as a common carrier, in transporting 35 horses (18 in one car and 17 in another) from Miami, Fla., to Richmond, Va., had confined them for a period of more than 28 consecutive hours, to wit, for 77 hours, without unloading them for any period of rest, water, and feeding. At the trial in the district court, the defendant undertook to justify its failure to unload the horses within the 28-hour statutory period by reference to that section of the law which makes not obligatory the requirement as to unloading in cases where the animals are carried in cars in which they can and do have proper food, water, space, and opportunity to rest.

It was shown, or it was admitted, that the horses had proper food and water during the trip, and the defendant alleged that horses rest while standing and introduced some evidence to that effect, though it was met by Government witnesses who testified that horses normally lie down to rest when they can do so with safety. The court also allowed the defendant to testify that these horses arrived at their final destination at Rye, N.Y., in good condition and in its decision found as a fact that the horses were carried in cars in which they had proper food, water, space, and opportunity to rest and therefore gave judgment for the defendant. The case was appealed and the Circuit Court of Appeals for the Fourth Circuit cited cases to show that "opportunity to rest" as used in the act means "opportunity to lie down." It declared that there was "not substantial evidence" upon which the lower court could base a finding of fact that these animals had an opportunity to rest and therefore reversed the judgment which had been given.

MIGRATORY BIRD TREATY ACT

(40 Stat. 755)

Three hundred and fifty-two cases were reported to the Attorney General under the Migratory Bird Treaty Act, and fines were imposed in 220 cases, as shown in table 9.

TABLE 9.—*Fines imposed under the Migratory Bird Treaty Act, fiscal year 1933*

Number of cases	Amount of fine	Total	Number of cases	Amount of fine	Total
4	$0.01	$0.04	2	$30.00	$60.00
1	.10	.10	2	35.00	70.00
11	1.00	11.00	9	50.00	450.00
40	5.00	200.00	9	100.00	900.00
6	7.50	45.00	2	300.00	600.00
57	10.00	570.00	2	500.00	1,000.00
10	15.00	150.00	1	1,800.00	1,800.00
8	20.00	160.00			
56	25.00	1,400.00	Total (220 cases)		7,416.00

Forty-one cases were dismissed for various reasons; 2 were quashed, and 29 nolle prossed; 4 cases were stricken with leave to reinstate, while in 14 cases the defendants were found not guilty; in 4 cases no true bill was found; 9 defendants were placed on 1 year's probation, 4 on 2 years' probation, 7 on 5 years' probation, and 1 on 6 months' probation, while in 13 cases sentences were entirely suspended

with the exception that such suspensions, in 5 instances, were predicated on 5 years of good behavior; 1 defendant was placed on probation without sentence; 1 defendant was given a 3-day jail sentence, 3 defendants were given 10-day sentences, 1 was given 11 days, and one 11 days plus 1 day in the custody of the United States marshal. In 2 cases 3-month jail sentences were imposed on the defendants, while in 6 other cases 30-day jail sentences were given, and in 1 case a 6-month jail sentence was suspended as the defendant was placed on probation for 2 years.

BIRD AND ANIMAL RESERVATION TRESPASS LAW

(Sec. 84 of the Penal Code)

Ten new cases were reported to the Attorney General under section 84 of the Penal Code. No cases were terminated during the year.

UPPER MISSISSIPPI RIVER WILD LIFE AND FISH REFUGE ACT

(43 Stat. 650)

Seventeen cases involving violations of the Upper Mississippi Wild Life and Fish Refuge Act were prepared and reported to the Attorney General for prosecution. Of the cases reported and those previously pending, 8 were closed. In 5 of these, fines were imposed totalling $60. In 1 case the defendant was placed on 18 months' probation; in another, 3 years' probation; and in the third, the defendant was given a 30-day jail sentence.

Fifty-five cases of land acquisitions, involving 4,513.79 acres, were terminated during the fiscal year. There remained 73 cases of which 5 are under title examination, 3 have been submitted to the Attorney General for approval of title, 38 are in process of condemnation, and 27 are ready to be included in condemnation proceedings.

Extensive testimony was taken before the United States commissioner upon the swamp or nonswamp character of the Lost Islands in Buffalo County, Wis., claimed by the State of Wisconsin and others. Also, considerable work has been performed in attempting to find an acceptable solution of this controversy.

Assistance was rendered by this Office to the United States attorneys in charge of numerous condemnation proceedings in the United States district courts in Iowa, Minnesota, and Wisconsin. Several of these cases were contested by the landowners, and extensive field and office work was necessary to assemble the evidence needed to establish the land values.

MIGRATORY BIRD CONSERVATION ACT

(45 Stat. 1222)

Thirty land-acquisition cases were closed during the year, involving the examination of titles to 47,720.89 acres. Titles to 16 tracts, involving 2,173.91 acres under option to purchase, were also investigated and abstracted, but not closed. Seven condemnation proceedings were instituted to vest valid title to certain tracts in the United States.

Legal opinions were given on numerous questions arising in connection with the administration of refuges and reservations.

BEAR RIVER MIGRATORY BIRD REFUGE EXCHANGE ACT

(45 Stat. 1186)

Extensive work has been done in an effort to consumate the land exchanges deemed of benefit to the Bear River Migratory Bird Refuge, and opinions have been given on the legal questions involved.

MALHEUR LAKE RESERVATION

(46 Stat. 1552, 1562)

The claims of the State of Oregon to the Malheur Lake Reservation are still pending before a special master, appointed by the United States Supreme Court in the suit entitled "*United States of America* v. *Oregon*." This matter is in charge of representatives of the Department of Justice, but assistance and cooperation have been freely given by the solicitor. Briefs on each side have been completed and filed, but the case has not yet been argued and submitted to the special master for decision.

CHARLES SHELDON REFUGE

The donation of 2,537.73 acres for the Charles Sheldon Refuge, in Wabash County, Nev., has been accepted, and title thereto has been approved by the Attorney General. Much legal work has been performed in effecting this transfer.

ALASKA GAME LAW

(43 Stat. 739; 46 Stat. 1111)

The regulations of the Secretary of Agriculture under the Alaska Game Law were revised, and opinions on questions arising out of the administration and enforcement of this law were rendered.

PACKERS AND STOCKYARDS ACT, 1921

(42 Stat. 159)

During the year there were instituted or reopened a total of 29 notices of inquiry as the basis of hearings under the Packers and Stockyards Act. There were 16 cases pending at the beginning of the fiscal year. Thirty-six were disposed of during that period, and 9 were pending at its close. The subject matter of the formal dockets dealt with stockyard rates, commission rates, solvency, trade practices, bonds, and reparation. Orders based on these dockets are as follows: 16 cease and desist orders, 8 orders of suspension, 3 prescribing rates, 8 dismissing the cases, and 1 revoking a suspension.

Attorneys of this Office appeared as counsel and officiated as examiners in a number of hearings held during the year involving the reasonableness of the rates and charges for stockyard services, and of rates charged by commissionmen. They so acted, also, in hearings based upon other violations of the act. The records of many of these hearings were carefully reviewed, and narratives of some of them were made by this Office in cooperation with the Packers and Stockyards Division of the Bureau of Animal Industry. Oral arguments have been made in several of the cases before the Secretary, and opinions have been furnished, from time to time, to the administrative officials interested in the various legal problems in the enforcement of the act.

Five proceedings, involving the alleged unfair practice of commissionmen in giving money and other things of value to truck drivers to induce them to consign livestock to the commissionmen were heard at St. Paul, Minn. After argument before the Secretary, these cases were dismissed.

The above-mentioned hearings were presided over by an attorney of this Office, as examiner, and at each of the hearings and arguments another attorney of this Office appeared as Government counsel.

CASES OF INTEREST

In *Inghram* v. *Union Stock Yards Co.* (64 Fed. (2d) 391), the Circuit Court of Appeals, Eighth Circuit, at Omaha, held that, in a suit by the stockyards company for the collection of charges from a dealer for use of the stockyards, a collateral attack could not be made by the defendant upon the schedule of charges approved by the Secretary.

In *United States* v. *Roberts & Oake* (65 Fed. (2d) 630), the Circuit Court of Appeals at Chicago held that a packer is not a dealer within the meaning of that term as used in the act and is therefore not subject to the regulations requiring dealers to give bonds to cover their purchases.

In *United States* v. *Donahue Bros., Inc.* (59 Fed. (2d) 1019), the Circuit Court of Appeals for the Eighth Circuit, at Omaha, held that a market agency occupies a fiduciary relation with respect to the shipper and may not use the proceeds from the shipper's sale of the stock without his consent. It was also held that the remission of the funds is a part of the market agency's duties.

CHEYENNE BOTTOMS REFUGE AREA

(46 Stat. 579)

Abstracts of title to 18,722.32 acres have been carefully prepared and studied for the purpose of completing the acquisition thereof for use in the Cheyenne Bottoms Refuge.

MOUNT VERNON MEMORIAL HIGHWAY

(45 Stat. 721)

The Government acquired, by purchase or condemnation, for the purposes of the Mount Vernon Memorial Highway, 14 tracts of land comprising approximately 84 acres, located in the city of Alexandria, and in Arlington and Fairfax Counties, Va. Of the land acquired, 8 tracts, comprising approximately 23 acres, were procured by purchase, and 6 tracts, comprising approximately 61 acres, were obtained by condemnation.

PUBLIC ROADS LABORATORY IN VIRGINIA

The Government acquired, by condemnation or purchase, for a laboratory for the Bureau of Public Roads, 4 tracts of land, comprising approximately 54 acres, located in the city of Alexandria and in Arlington County, Va. Of the land acquired, 2 tracts, comprising approximately 34 acres, were procured by purchase, and 2 tracts, comprising approximately 20 acres, were obtained by condemnation.

CROP-PRODUCTION LOANS

Legal work incident to the administration of the several crop-production and seed loan acts was handled by the Solicitor until all the work involved in these projects was transferred to the newly created Farm Credit Administration, in compliance with Executive Order No. 6084, of the President, issued March 27, 1933. At the time of the transfer, which occurred on May 27, much work having to do with collection activities and criminal offenses arising under the various acts had been completed by this Office.

During this period there were forwarded to the Attorney General, for appropriate civil and criminal action, 185 cases involving loans made under the 1929, 1930, and 1931 seed loan acts; 5 civil cases arising under the act of February 14, 1931, and 130 civil or criminal cases arising under the Crop Production Loan Act of 1932. In addition to this a total of 681,782 loan applications and accompanying papers were examined by representatives of this Office. Loans aggregating $53,720,325 were thereafter made to 611,705 applicants for 1933 crop-production purposes.

Advice was frequently given to administrative officials, both orally and in writing, with regard to loan and collection procedures, and information was furnished to all who made inquiry concerning the several loan acts. All forms necessary for use in making 1933 loans were prepared by this Office, and a number of proofs of claims which were filed in cases where seed and crop-production loan borrowers had died or had been adjudicated bankrupts, were furnished. Numerous legal opinions were given to administrative officials, interpreting complicated provisions of the several acts, the regulations thereunder, and the forms used in connection therewith.

During the year a total of 46 civil and criminal seed and crop-production loan cases were settled and closed. The seed and crop-production loan work of the Office, considering its nature, was current at the time it was turned over to the Farm Credit Administration.

PRODUCE AGENCY ACT

(44 Stat. 1355)

A total of 28 cases charging violations of the Produce Agency Act were referred to this Office by the Bureau of Agricultural Economics. Of these, 27 were forwarded to the Department of Justice for prosecution. Convictions were obtained in 12 cases; sentences were imposed in 9 of these, and in 3 of them the courts deferred the imposition of sentences temporarily. The penalties imposed ranged from the minimum fine of $100 to a maximum of $250, and from 6 months' probation in 1 case to 3 months' imprisonment in 3 cases. Fines imposed and collected totaled $851.

CASES OF INTEREST

In the case of *United States* v. *George B. Long* in the United States District Court for the Western District of New York, the defense sought the dismissal of the action on the ground that interstate commerce was not involved and that, therefore, the Government had no jurisdiction over the matter. The facts were that the owner shipped a carload of onions from storage at Erie, Pa., to a purchaser at Niagara Falls, N.Y., where they were rejected. After remaining there

approximately 1 week, the car was backhauled to Buffalo, N.Y., where it was handled by the defendant on consignment. No accounting of the sale was made. An attorney from this Office assisted in the preparation of the Government's argument that interstate commerce had not ended, and the Government's contentions were borne out by the court's ruling that it was a question of fact for the jury. The jury found that interstate commerce had not ceased, and the defendant was convicted.

In the case of *United States* v. *Robert T. Cochran & Co., et al*, pending in the United States District Court for the Eastern District of Washington, proceedings were instituted in the United States District Court for the Northern District of California, for the removal of two of the defendants, Lindsay W. Cochran and Edward Broome. The United States commissioner ordered their removal. A writ of habeas corpus was sought from the United States District Court for the Northern District of California and was refused. An appeal from this decision was taken to the United States Circuit Court of Appeals for the Ninth Circuit. No decision has yet been rendered.

PERISHABLE AGRICULTURAL COMMODITIES ACT

(46 Stat. 531)

Four hundred and ninety-nine complaints were filed and served under the Perishable Agricultural Commodities Act. Formal hearings were held by attorneys from this Office in 205 cases, and 371 orders were prepared and issued. Of these, 233 orders were issued in cases where formal hearings were held in this and in the previous fiscal year, and 138 were issued in cases submitted under the shortened procedure regulation. Three hundred and fifty-four cases remained pending at the end of the year.

A large number of awards of reparation were entered, and in some cases of flagrant or repeated violations the licenses of the offenders were suspended or revoked.

Two cases were forwarded to the Department of Justice requesting the institution of suits on behalf of the United States for the collection of penalties for doing business without a license in violation of the act. One such case was compromised by the payment of a penalty of $100.

A great many legal opinions were prepared by this Office covering various phases of the act.

STANDARD CONTAINER ACTS OF 1916 AND 1928

(39 Stat. 635; 45 Stat. 685)

Two cases under the standard container acts were forwarded to this Office for attention, and in each case prosecutions have been instituted. Numerous conferences were held with officials of the Bureau of Agricultural Economics and with representatives of the trade, relative to the administration of the act.

A CASE OF INTEREST

In the case of *United States* v. *Yates Lumber Co.*, prosecuted in the United States District Court for the Western District of New York, the charge was made that the defendant had violated the 1916 act through the manufacture and shipment of a large number of climax baskets for mushrooms. The Government contended that the baskets did not conform to the standards established by the act governing the sizes of such baskets when used for "grapes and other fruits and vegetables." The matter is before the court for decision on the issue whether mushrooms are within the meaning of the words of the act as above quoted. This Office forwarded a number of memoranda on the point for the use of the United States attorney in the preparation of his brief. No decision has yet been rendered.

UNITED STATES COTTON FUTURES ACT

(39 Stat. 483)

A number of oral and written opinions were given to the administrative officials on legal questions arising in the enforcement of the United States Cotton Futures Act.

UNITED STATES COTTON STANDARDS ACT

(42 Stat. 1517)

Amendments to the regulations for the enforcement of the United States Cotton Standards Act were reviewed by this office for their legal sufficiency. Oral and written opinions were given to the administrative officials for their guidance in administering the act, and a number of orders issued by the administrative officers were examined and approved. Representatives of the Office attended sessions of the International Universal Cotton Standards Conference of 1933.

UNITED STATES GRAIN STANDARDS ACT

(39 Stat. 478)

Opinions were rendered to the administrative officers on legal questions arising in the enforcement of the United States Grain Standards Act. A number of cases involving violations of the law, in which hearings were held, were reviewed for publication of the facts. Proposed regulations under the act were also reviewed as to their legal sufficiency.

UNITED STATES WAREHOUSE ACT

(42 Stat. 486)

Opinions were rendered to the administrative officers on legal questions arising in the enforcement of the United States Warehouse Act. Proposed regulations were examined for their legal sufficiency. A number of alleged violations of the act were given consideration, and one of them was forwarded to the Department of Justice for prosecution.

UNITED STATES GRAIN FUTURES ACT

(42 Stat. 998)

The power of the Secretary to require reports from operators on grain futures markets and the right of agents of the Department to inspect the books and records of firms dealing on the futures markets were upheld by Federal Judge Wilkerson at Chicago in a decision rendered February 12, 1932, dismissing the petition for an injunction filed by the Bartlett-Frazier Co. against Arthur M. Hyde, et al. The decision was affirmed by the Circuit Court of Appeals for the Seventh Circuit (65 Fed. (2d) 350). The constitutionality of the act was upheld by the Court of Appeals under the decision of the United States Supreme Court in *Chicago Board of Trade* v. *Olsen* (262 U.S. 1). It declared that the fourth amendment of the Constitution against unlawful searches and seizures cannot be applied to regulations in respect to a business affected with a public interest where the examination is necessary for the protection of the public. It also held that the fact that the regulation made no provision for the Bartlett-Frazier Co. to be heard, prior to the examination of their books and records, is not a taking of property without due process of law and is not in violation of the fifth amendment to the Constitution. This case is now pending before the United States Supreme Court on a writ of certiorari.

In the case of *Dickson* v. *Uhlman Grain Co.* (288 U.S. 188), the Supreme Court of the United States rendered a decision of interest in connection with the operation of grain futures markets and the administration of the United States Grain Futures Act. It held that, on the facts in the case, there were two distinct agreements, one between the customer and the company, and the other between the company and brokers on contract markets and that, since the customer's agreement did not contemplate a transaction on the contract market, it was subject to the State law and the Grain Futures Act did not apply.

A formal complaint was filed with the Grain Futures Commission, created under the act, by the Farmers National Grain Corporation (a cooperative association sponsored by the Federal Farm Board under the provisions of the Agricultural Marketing Act) against the Chicago Board of Trade and the Board of Trade Clearing Corporation. The complainant alleged that it had been denied membership in the Board of Trade Clearing Corporation and that this denial prevented it from clearing its futures trades in its own name, and that the denial of this privilege by the respondents, resulting in considerable expense to the complainant, was a violation of section 5 (*e*) of the Grain Futures Act. The section of the

statute cited required that a board of trade, which has been designated by the Secretary of Agriculture as a contract market, must admit to membership therein, and all privileges thereon, the

duly authorized representative of any lawfully formed and conducted cooperative association of producers having adequate financial responsibility which is engaged in cash grain business, is such association has complied, and agrees to comply, with such terms and conditions as are or may be imposed lawfully on other members of such board (of trade).

Pursuant to the complaint of the cooperative association, a hearing was held June 8–11 before the above-mentioned commission. After considering the evidence adduced at the hearing and the arguments of counsel, the commission on July 23 announced its decision that the complainant was entitled, under the Grain Futures Act, to all the privileges of the Chicago Board of Trade, including the privilege of clearing its futures trades in its own name, and that the denial of this privilege by the respondents was in violation of the statute. The commission, by the terms of the act, is restricted, in the imposition of a penalty upon a board of trade for the violation of section 5 (*e*) of the statute, to suspending or revoking such board of trade's designation as a contract market, subject to the right of appeal to thec ircuit court of appeals. Pursuant to its findings in this case, the commission ordered the contract market designation of the Chicago Board of Trade suspended for a 60-day period, reserving jurisdiction to mitigate such penalty upon a showing that the board of trade had receded from its position with respect to the complainant cooperative association. An appeal was filed by the respondents, and the case is now pending in the Circuit Court of Appeals for the Seventh Circuit.

COLLECTION AND DISTRIBUTION OF PROFITS OF WOOL CLIP OF 1918

In the early part of the fiscal year the Circuit Court of Appeals for the Seventh Circuit handed down a decision in *United States* v. *Kraus* (61 Fed. (2d) 886), which showed that further effort to obtain an authoritative decision upon the fundamental questions involved in actions to collect the excess profits realized by dealers in handling wool of the domestic clip of the year 1918 was useless. Accordingly, on recommendation of the Secretary, the Attorney General directed that all pending cases be dismissed without prejudice and that no further actions be instituted. Thereupon the work of collecting the excess profits realized by dealers in handling wool of the domestic clip of the year 1918, under regulations made by the War Industries Board, came to a close.

PATENTS

One hundred and thirty-three applications for letters patent covering inventions made by employees of the Department were given consideration during the year. Fifty-six new cases were prepared and filed in the Patent Office during the year, an increase of 20 over the preceding year. Thirty applications have been passed to patent. There are pending before the Patent Office 88 applications.

The Office has taken part in eight interference procedings declared by the Patent Office between applications for letters patent of employees of this Department and applications filed by outside parties. These proceedings involved the formal taking of testimony by the parties to the controversy, the filing of motions, the preparation of briefs, the submission of appeals to the various tribunals of the Patent Office and the Court of Customs and Patent Appeals, and the presentation of oral arguments. Three interferences have been concluded favorably to the Department employees; 2 cases are pending before the Court of Customs and Patent Appeals, 1 having been appealed by the Department and 1 by the outside party, and 3 interference cases are now pending before the Patent Office. Many informal conferences were held with the examiners and numerous responses to actions of the Patent Office were prepared and filed.

Many questions presented by officials of the Department, bearing on various phases of patent, trade mark, and copyright laws, were considered and advice given.

The work of the Office, considering its nature, was current at the end of the year.

U.S. GOVERNMENT PRINTING OFFICE: 1933

REPORT OF THE CHIEF OF THE WEATHER BUREAU, 1933

UNITED STATES DEPARTMENT OF AGRICULTURE,
WEATHER BUREAU,
Washington, D.C., September 21, 1933.

SIR: I submit herewith a report of the work of the Weather Bureau during the fiscal year ended June 30, 1933.

Respectfully,

C. F. MARVIN, *Chief.*

Hon. HENRY A. WALLACE,
Secretary of Agriculture.

Drastic economies, retrenchments, and suspension of public service have characterized the program of Weather Bureau work from the beginning of the fiscal year 1932 to the present time.

During this period not only have large reductions been made in the annual appropriations but also the appropriations made have been expended with great economy, resulting in large unobligated balances which augmented the reductions and increased the savings. In the early portion of the period changes were made that would entail the least harm to the general public service, but the program for the fiscal year ending June 1934 has necessitated the saving of over $800,000 from the appropriation as passed by Congress. This has resulted in the closing of more than a score of primary first-order stations and large numbers of substations of all classes, and has involved the dismissal of nearly 500 employees.

It is believed that a rigid investigation of the administration of activities of the Weather Bureau will show conclusively that its affairs have been carried on with marked economy and efficiency over many years of operation.

The normal functions of the Weather Bureau cover a wide range and are not duplicated to any appreciable extent by any other Government agency. Accordingly, further economies than have already been accomplished in the cost of the Weather Bureau service to the Nation as a whole can be effected only by reductions and curtailments in long-established service to the general detriment of agriculture, commerce, and navigation.

The newest activity of the Weather Bureau, namely, its service in aid of air navigation, has come so much to the attention of certain of the public engaged in this particular field that the impression prevails that the service rendered this new industry has now become the major activity of the Weather Bureau. This is grossly erroneous and must continue to be so indefinitely if the Bureau effectively performs all of the duties assigned to it by organic law.

WEATHER BUREAU ACTIVITIES

Following is a list of the principal activities of the Bureau, which indicates the relative part of the whole comprised in the meteorological aids to air navigation:

1. *Primary network of stations.*—The Bureau has charge of the establishment, equipment, and maintenance by trained personnel of a primary network of about 200 first-order stations overspreading the continental United States and its possessions, except the Philippines. Twice-daily telegraphic reports and other observations, reports, and automatic records from these stations, including numerous radio reports from ships at sea, also the twice-daily exchange of numerous observations between nearly all the great nations of the Northern

Hemisphere constitute the foundation of all classes of the public service of the Bureau, including aids to air navigation.

2. *Twice-daily public forecasts of all kinds.*—General weather forecasts are issued twice daily, Sundays and holidays included, throughout the year for all States, parts of States, and the larger cities. These include radio broadcasts from more than 300 radio stations of numerous weather bulletins for the benefit of all classes of the public, press notices, bulletins, etc., and also Navy broadcasts from Arlington and San Francisco of the coded and other weather reports for use by the shipping interests, the military branches of the Government, students, and specialists.

3. *River gaging and flood warnings.*—The daily gaging and reporting of stages of all the principal rivers of the continent are made by the Bureau. This service includes the indispensable flood-warning service at all times of heavy rains and the flood seasons of the year.

4. *Hurricane warnings and storms on the Great Lakes.*—This is a special service from June to November, comprising invaluable hurricane warnings for the benefit of all shipping plying the adjacent oceans, the Gulf of Mexico, and Caribbean Sea. This includes, of course, the property savings and other benefits to the commerce and industries of all the coastal States visited by hurricanes, especially the protection of the lives of many residents and citizens.

5. *Secondary network of stations.*—The Bureau maintains over 1,200 secondary stations (not including any airway stations), which furnish simple reports of rainfall, river, weather, and crop conditions, and receive a small compensation ranging from $10 to $25 per month.

6. *Network of climatic stations.*—The Bureau also has a vast network of cooperative observers. These are public-spirited citizens residing mostly in rural districts, who, because of their personal interest in the weather, make daily records of the maximum and minimum temperature, the rainfall, and state of weather, including notes on special meteorological phenomena. The instruments and forms for reports are supplied by the Government, but the service is performed without any monetary compensation whatsoever. There are now about 5,000 such observers. The Nation owes a great debt of gratitude to these faithful observers. Their observations for more than half a century give an invaluable index of every important feature of the climate of almost every county in the whole Government domain, except the Philippines, in which the meteorological work is in the hands of the local government.

7. *Weekly bulletins of crop-weather conditions.*—Incidental to the daily and weekly reports from the 200 first-order and the 300 secondary stations, the Bureau issues a weekly bulletin of weather and crop conditions. In the winter season this includes details of snow and ice conditions. During the growing season of the year these weekly bulletins furnish authoritative facts on drought and current weather conditions and suppress or refute wild rumors and misinformation which would otherwise arise and which would seriously affect the orderly farm management, harvesting, and marketing of all the great agricultural crops.

8. *Frost warnings for horticulture.*—The Bureau maintains a thoroughly organized frost and cold-wave service for the benefit of citrus growers and orchardists located in Florida, Mississippi, Texas, California, Oregon, and Washington.

9. *Shippers' forecasts, cattle and stock-raising service.*—Warnings of temperature and cold waves are issued for the shipment of perishable products and livestock, and for the care and protection of livestock on the range in winter and at shearing time in the spring.

10. *Solar-radiation investigations.*—The Bureau investigates and measures the intensity of solar radiation at the surface of the earth. It is well known that solar radiation is the ultimate source of all terrestrial weather and life.

All the foregoing items of activity cover the services of the Weather Bureau to the general public, to agriculture, commerce, and navigation other than air navigation. The whole program is the growth and development of 62 years of experience.

11. *Aid to air navigation.*—The Air Commerce Act of 1926 specifically directs the Weather Bureau:

> To furnish such weather reports, forecasts, warnings, and advices as may be required to promote the safety and efficiency of air navigation in the United States and above the high seas, particularly upon civil airways designated by the Secretary of Commerce under authority of law as routes suitable for air commerce, and for such purposes to observe, measure, and investigate atmospheric phenomena, and establish meteorological offices and stations.

Table 1 shows the actual amounts of appropriations and savings that have been effected practically since January 1, 1932, to the present time.

TABLE 1.—*Appropriations for the Weather Bureau and savings effected, 1932–34*

Fiscal year	Appropriation	Legislative and all voluntary savings				
		Cut in appropriations	Cuts in all public service	Pay and wage cuts	Vacancies unfilled	Total savings
1932	$4,497,720	----------	[1] $332,966	----------	$32,743	$365,709
1933	4,164,038	$333,682	246,847	$277,318	115,284	639,449
1934	3,731,235	[2] 2,909,884	382,760	[3] 444,481	193,352	825,351

[1] Fully two thirds of this saving was effected in 1932 by the suspension or partial inauguration only of extensions in aids to navigation of the air for which appropriations had just been made. In other words, the work was not inaugurated and has been in a state of partial development since that time.

[2] Cash withdrawal authorized June 22. The set-up under this limitation of expenditure could not be made effective until about Aug. 1, 1933. Of course all the items of savings for 1934 are merely close estimates and may probably be exceeded by the amount of a small unexpended balance at the close of the year.

[3] Gross savings on an annual basis resulting from the 15-percent cut in pay and wages of all Weather Bureau employees, including also about $50,000 which must be absorbed by administrative furloughs of all commissioned employees. The amount of the gross saving will be reduced by any change in the 15-percent cut made prior to June 30, 1934.

Under the law the responsibilities imposed upon the Weather Bureau are unique and exacting. No other agency of the Government is in any way specifically directed to engage in and conduct meteorological work, except possibly the nucleus of meteorological activities organized in the military branches for purely military needs. Through the nearly 200 fully-equipped stations of the Bureau, the contact of the personnel with the industries and the public is very close, and all those making up the personnel are keenly alert to their respective responsibilities, especially during times of extreme weather conditions such as severe cold waves, floods, hurricanes, and the like. For example, it is difficult for the public to realize the intense activity at a Weather Bureau station during the prevalence of a hurricane. The ordinary legal hours of duty and considerations of Sundays and holidays have no meaning. No more loyal and faithful body of Federal employees can be found than at Weather Bureau stations. On many occasions the men remain on duty during long hours, often throughout the entire night, snatching such moments for food, rest, and sleep as may be possible. The number of personnel has always been limited and the average compensation relatively low in the Federal service.

If the gross appropriation for 1932 is compared with the cash-withdrawal authorization available for 1934, it is seen that the total saving in conducting the work of the Weather Bureau amounts to $1,587,836. Comparisons of the items also indicate that the savings resulting from unfilled vacancies, compulsory and involuntary retirements, and cuts in pay and wages of all classes of personnel have in the aggregate exceeded the actual savings effected by cuts in all classes of public service. In a few words, by dismissals, pay cuts, furloughs, and increased work due to reduced force and unfilled vacancies, the personnel of the Weather Bureau is now bearing the brunt of more than half the economies effected in the maintenance of the service as planned for the fiscal year 1934.

REDUCTIONS IN PUBLIC SERVICE

To effect the economies outlined it was first necessary to close a number of so-called "first-order" stations of the Weather Bureau or to reduce the duties and responsibilities in a material way. The following is a list of these stations, the new status being indicated in parentheses:

Apalachicola, Fla. (second order).
Concord, N.H. (second order).
Dayton, Ohio (river and cooperative).
Fort Worth, Tex. (reduced in personnel and service).
Grand Haven, Mich. (cooperative and storm warning).
Greenville, S.C. (cotton region and cooperative).
Hannibal, Mo. (river and cooperative).
Hartford, Conn. (reduced in personnel and service).
Houghton, Mich. (storm warning and cooperative).

Lewiston, Idaho (river and cooperative).
Lexington, Ky. (second order).
Ludington, Mich. (second order).
Lynchburg, Va. (second order).
Pierre, S.Dak. (river and cooperative).
Port Angeles, Wash. (storm warning and cooperative).
Port Huron, Mich. (storm warning and cooperative).
St. Paul, Minn. (river).
San Jose, Calif. (cooperative).
Tacoma, Wash. (storm warning).
Taylor, Tex. (cotton region and cooperative).
Thomasville, Ga. (second order).
Wausau, Wis. (river and cooperative).
Yankton, S.Dak. (river and cooperative).

In addition, a program of curtailment of service along airways is now being worked out. The stations are all secondary ones devoted exclusively to airway work, and a list cannot be given at this time.

In addition to closing some stations and reducing the status and activities of others, savings have been effected by closing 30 storm-warning, 11 second-order, 5 tobacco, 46 cattle-region, 97 crop-weather, 84 river and rainfall, and 7 snowfall stations, and reducing the pay status in many others. The number of places to which daily forecasts are telegraphed has been reduced by more than 125, and a heavy reduction has been made in the distribution of forenoon and afternoon coded telegraphic reports. In other cases the issuing of weather maps has been suspended or changed to card bulletins. Telegraph expenses have been drastically curtailed. Corresponding economies will be applied to flood and storm warnings, fruit-frost, fruit-spray, and all other projects.

The closing days of the fiscal year were occupied in hastily projecting the extensive program of reduced service for the fiscal year 1934 which, as already stated, became substantially effective as of July 31, 1933. While very substantial savings were effected in the expenditures for 1933, nevertheless the general program of work was not harmfully affected. Practically all lines of activity were carried forward in nearly normal fashion except that important researches in solar radiation and climatology were abruptly suspended by the retirement of the leaders of these projects.

Notwithstanding the economies mentioned in the foregoing it became possible to inaugurate, at small cost, an important plan for increasing the number of ships' reports during the prevalence of tropical hurricanes. This is briefly described below:

Beginning June 1, 1933, the Weather Bureau put into operation a supplemental plan for securing weather observations by radio from ships at sea in connection with hurricanes. Arrangements were made with certain radio companies whereby direct requests are made for weather reports at designated hours from ships known to be in areas in which a tropical disturbance is in progress.

All warnings of hurricanes are issued from Washington. When conditions warrant, the forecaster on duty indicates the ocean areas in which a tropical disturbance is known or suspected to be in progress and from which observations are desired. This information is at once telegraphed to officials in charge of designated Weather Bureau offices who have contact with the operators of the radio stations involved. The operators are advised of the hours at which the observations are needed and the ocean zones from which they are desired. All ships, regardless of nationality, in these zones are requested by special message to take weather observations at the designated hours and transmit them by radio in a coded message to "Observer, Washington."

This arrangement was designed with a view to assuring the receipt of weather reports when they are urgently needed from ships with which it is impracticable to make arrangements in advance. Hurricane activities in the Caribbean Sea and Gulf of Mexico began unusually early in the 1933 season. The new method has already demonstrated its practicability and success as a supplement to that in operation in previous years.

In the operation of its hurricane-warning service, the Weather Bureau has, for a number of years, secured daily weather observations from continental and island stations and from ships at sea. When a tropical storm is in progress over the water at a distance from island and coastal stations, dependence must be placed almost wholly on ships' weather reports by radio. For this purpose the cooperative services of the masters of about 300 merchant ships have been enlisted to transmit, during the hurricane season, twice daily, radiograms containing standard weather information. The ships are selected so as to afford as nearly as possible a representative daily collection from all areas in which West Indian hurricanes are likely to occur.

A representative collection is not realized every day during the hurricane season, because the number of ships in hurricane areas varies greatly from day to day and some areas are rarely traveled. Another difficulty is that when a storm is in progress, the fact is known to mariners through the daily weather bulletins and advices broadcast by the Bureau and shipmasters naturally avoid the storm area as far as possible. Therefore, it frequently happens that few or none of the ships with which arrangements for daily observations have been made are close enough to the storm center to enable the forecaster to form an accurate judgment as to its future behavior. By the new plan if there are any ships in the storm zone, reports therefrom are likely to be obtained.

For several years it has been the practice of the Weather Bureau to broadcast appeals by radio to shipmasters for weather reports when tropical storms are in progress. While this has yielded valuable results, it is inadequate because the appeals may not reach ships on which the complete weather broadcasts are not copied. Moreover, many ships do not have regular schedules and are routed into hurricane areas at intervals of several months. Yet such ships form a very considerable proportion of the traffic in the hurricane belt, and no regular reporting program for them can be arranged in advance.

A marked advantage of the new plan is that it utilizes radio operators' knowledge of the location of ships at sea so as to secure direct contact with the masters of all ships that are located within the storm area, from many of whom no reports otherwise would be obtained. The response to direct calls sent to ships of all national registers has been gratifying, but this was fully expected because of the very hearty cooperation the Weather Bureau has always received from shipmasters.

OCEAN METEOROLOGY

During the year, the 3-year project of recomputation of all meteorological data for the Central American Waters Pilot Chart was brought to completion. A discussion of the relation between sea surface and air temperatures in that area was prepared and published.

Investigation into the sources of temperature variations in the Gulf Stream at one of its principal origins (the Florida Straits) was substantially advanced, and conclusions are about ready for publication.

Atmospheric variation is found by these studies to play a primary role in the causation of the seasonal and irregular fluctuations in the average temperature of waters at the origins of the Gulf Stream.

The daily synoptic weather maps of the Northern Hemisphere have been improved in respect to the entry of observations from the oceans. A campaign of improvement has been pursued in two directions: (1) Special efforts have been successful in securing additional reports from ships sailing into sea areas which were poorly represented in the reports previously available; and (2) the cooperation of ships' officers and operators has been diligently sought with the object of improving the quality of ships' meteorological instruments and the accuracy of observation. Material results are being obtained; many inferior barometers and thermometers have been replaced with instruments of satisfactory quality by the ships' operators without expense to the Bureau.

The Marine Division is assisting in the international polar-year program, by transcription of over 100,000 regular ships' weather-observation records for use of the Polar Year Commission.

Improvement in shipboard meteorological equipment has been obtained without issue of Bureau-owned instruments, through successful enlistment of the cooperation of ships' officers and operators.

Some economies have been effected by a change in the style of record book used at vessel-reporting stations.

RIVER AND FLOOD SERVICE

Observations have been made of river stages, rainfall, and mountain snowfall. River stages are being published in volume XXX of Daily River Stages, now at the Government Printing Office. Rainfall and mountain-snowfall observations have been published in the monthly statements of climatic data, issued by the several climatic section centers of the country. The data appearing in these publications are used to a great extent in the flood-control work of the Federal Government, the States, and of the numerous drainage districts that have been organized in various parts of the country. They are also employed

and are considered indispensable by water users of all kinds throughout the United States.

The daily river forecasts made for the principal rivers have been used, as in the past, by navigation interests, hydraulic engineers, and the vast number of people interested in an advance knowledge of river stages.

Flood warnings have been successfully made and issued for all of the major streams in which floods have occurred in the last year. The floods of the greatest importance were in the Ohio River, the Yazoo River of Mississippi, and the Columbia River. Timely warnings of all of these floods were issued, and the public appreciation of their value is attested by the numerous commendatory letters and newspaper articles that have been received in the central office.

There have been demands for an expansion of the flood-warning service, but it has been impossible to meet them, on account of the lack of funds available for the river work. In fact, in June 1933, it became necessary to reduce the expenditures for this work by $12,562, which represents a reduction of almost 20 percent under the amount authorized for 1933, and the Bureau enters the fiscal year 1934 with a greatly changed organization for river work. In effecting the necessary reductions, an effort has been made to trim the work where the least harm to the public interests will follow.

SERVICE IN AID OF AIR NAVIGATION

The Bureau now maintains quite adequate service over about 25,000 miles of civil airways, including the maintenance of 500 cooperative and paid secondary stations on the airways. On 13,000 miles the service is continuous night and day as required by various schedules of flying during the 24 hours. The service over the remaining 12,000 miles is part time and is adjusted most effectively to the flying schedules mostly those in the daytime.

From the very nature of this service, more than half of which is continuous throughout the 24 hours, thereby involving at least three shifts of trained meteorologists, the cost is necessarily relatively more expensive to maintain than are the varied and comprehensive services to the public, agriculture, and industries. It is perfectly certain that safe navigation of the air is more or less impossible without a well-organized meteorological service. On the other hand, it is erroneous to belittle the benefits which the general public, agriculture, and the national industries realize from the old organized work of the Bureau and to subordinate the importance of a full continuance of this service under the mistaken impression that the new and somewhat spectacular service in aid of aviation dominates all other services in importance.

AIRPLANES DISPLACE KITES IN UPPER-AIR INVESTIGATIONS

The use of kites as a means of upper-air exploration was first begun as a regular program by meteorological services during the last decade of the nineteenth century. In this work the Weather Bureau was one of the early pioneers. As the value of the data thus secured became more and more apparent, the work was extended and for some years the Bureau had six stations in operation. This method, although it yielded results of genuine importance, nevertheless had decided defects since it was dependent on the wind conditions. That is to say, kite flights were not possible if the wind was very light or very strong. While using the kites, therefore, the Weather Bureau, in common with meteorological services of other countries, was constantly seeking some more satisfactory method.

The advent of the airplane provided this and in addition was a compelling cause for the abandonment of kite flying, owing to the hazards that the latter offered to aerial navigation. Accordingly, 2 years ago the Weather Bureau changed from kites to airplanes, although one of the kite stations was retained for a while, in order to be certain that, before that method was finally given up, the newer method would prove a success. This was amply demonstrated during the 2 years just completed, and, accordingly, the last kite station has now been discontinued and this phase of meteorological observation and investigation passes into history.

The record of the last 2 years with airplanes has shown that daily observations, almost without interruption, even during seasons of the worst weather, can be made up to a height of 15,000 feet. The data thus secured are of great value, both in the forecasting work of the Bureau and also for studies of the characteristics of the upper atmosphere. Studies of this type already made

have provided aids in forecasting, and it is certain that very much more of value along this line will be realized by further studies of the data, particularly if a more complete network of stations can be established.

The chief lines along which economies have been effected are:

1. Discontinuing substations at points along the airways.
2. Cutting down the number of observations at certain places.
3. The old program of 3-hourly observations was changed to a 4-hourly basis, thus making possible a considerable saving both in personnel and in the cost of telegraphing.
4. At certain selected stations, a program has been put into effect, whereby observations that are regularly taken are not telegraphed when weather conditions are favorable. The determining factors as to whether or not the weather is favorable are not left to the judgment of the observer but are rigidly set forth in instructions that have been issued to all stations.
5. Finally, by cooperation with the Department of Commerce, the personnel of that Department has been utilized at certain points where practicable in making surface weather observations, thereby dispensing with an airways observer otherwise paid by the Weather Bureau.

INSTRUMENTAL EXPOSURES

One of the serious problems confronting the Weather Bureau has long been the matter of securing good exposures for its instrumental equipment, particularly at stations in large cities. In such cases the offices must be located in the heart of the business activities in close touch with telegraph and newspaper offices, as well as the leaders of the major industries, boards of trade, commodity exchanges, etc. Finally, the extension of the public-building programs involves the saving of rent by the occupation of quarters in Federal buildings wherever possible. These often afford inferior or unsatisfactory conditions of exposure. In some of these cases instruments have been exposed on rented roof spaces on adjoining commercial buildings. This procedure has been gone into rather reluctantly because it is recognized that the observer should be in close attendance upon his instruments and should have ready access to them at all times. However, the widespread Federal building program together with the great need for economy has left no alternative but to work out the best possible arrangements for occupancy of these Federal buildings.

Notwithstanding these difficulties observations at city stations are carefully checked against certain observations at cooperative stations maintained under rural conditions, and it is believed that in the main the records from city stations are as accurate as practicable.

Wind velocities alone are probably the most seriously effected. In fact, the velocity of wind is such a complicated function of the irregularities of the local topography and the height of the instruments above the ground or the roofs of buildings in the vicinity that the observation itself must be interpreted with reference to the actual environment.

INTERNATIONAL POLAR YEAR

One of the notable features of the year beginning August 1, 1932, and ended August 31, 1933, is the international program for making certain meteorological and other scientific observations by all the meteorological services of the world comprising observations from the entire globe but particularly from stations in the Northern Hemisphere and as near the polar regions as possible. A brief report of this project follows:

An undertaking of genuine significance in the history of meteorology was the organization of an international program of observations, covering the period August 1882 to August 1883, inclusive. The data secured from a wide network of stations, including some within the Arctic Circle, formed the basis of many valuable researches.

As a fitting tribute to the memory of those who organized this first international polar year, it was decided at an international meeting of meteorologists some 4 or 5 years ago, to organize a so-called "Jubilee International Polar Year", this second program to be carried out exactly 50 years after the first, or in other words, during the period August 1932 to August 1933, inclusive. Through international conferences and correspondence, the proposed program was very carefully and completely planned and in spite of the unfavorable world-wide economic conditions has been carried out with only a small amount of modification.

This second polar year is naturally much more complete than the first one and has been organized on somewhat different lines. The primary purpose of the first effort was to secure statistical data. Although this is one of the purposes of the second program now completed, the chief goal in this one has been securing observations which would make possible the preparation of detailed weather maps on a world-wide scale from the study of which it is hoped valuable aids to forecasting may be developed. Naturally, the vastly improved methods in communication, including particularly the radio, have greatly assisted in this feature of the project and have also greatly simplified the organization of the work itself, since it has thus been possible to keep in close touch with all observing parties.

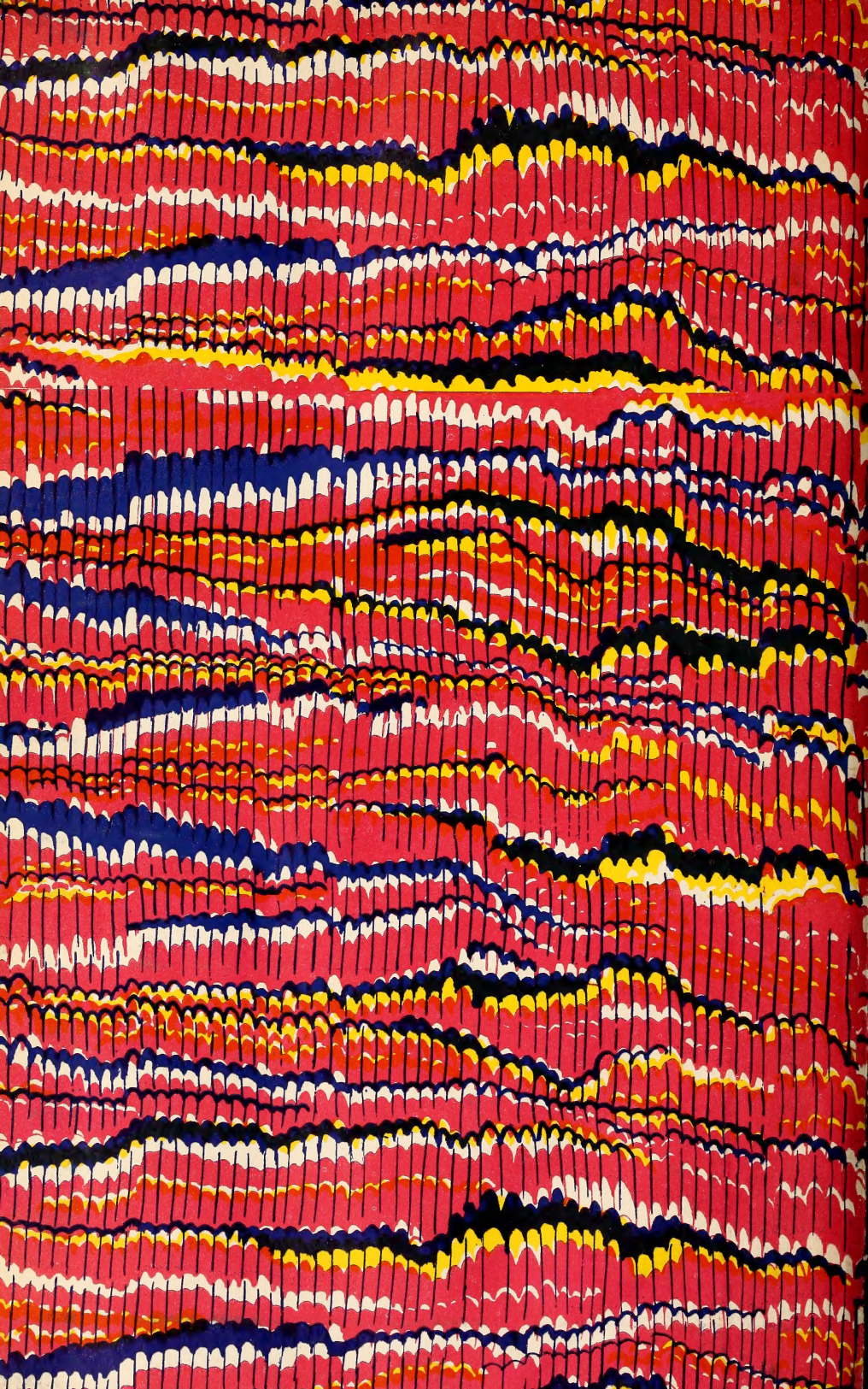
The Weather Bureau has taken an active part in this program. A special observing station was established at Point Barrow, Alaska, which is the point farthest north under the control of the United States. At this station a very complete set of surface records has been secured, and upper air soundings have been made with pilot balloons two or more times daily throughout the year. In addition, numerous photographs have been made of the aurora and a complete record kept of the occurrence of this phenomenon, including in some cases measurements of its altitude. Moreover, additional observations, as requested by the International Polar Year Commission, have been made at selected stations throughout the United States and its possessions. The observations included not only data of surface conditions but also of clouds and aurora and other phenomena. The upper-air part of the program consists of pilot balloon observations two to four times daily at about 70 stations; airplane observations, reaching a height of about 5 kilometers, as a rule, daily at 5 stations in the United States proper, from August 1932 to June 1933, inclusive, and at 4 stations during July and August 1933; airplane observations on selected days of each month only, at Fairbanks, Alaska; and sounding balloon observations, reaching heights of 8 to 15 miles in general, on specified days of each month, at 3 stations in the United States. In addition, a few high soundings by means of a special radio device have been made at Fairbanks.

Plans are being worked out for the compilation and analysis of the data that have thus been secured throughout the world. Already much of the work of compilation has been completed, but there remains the more important work of publishing the material in such form as to be readily available for study by qualified investigators. It is not yet certain whether publication will be by an international bureau or by the individual countries, in a form that may be prescribed by the International Polar Year Commission. In either case, the Weather Bureau expects to assume its full share in this part of the program as in that already completed, namely, the actual securing of the data.

RESEARCH WORK

The Weather Bureau is not organized for research activities in the same sense that research constitutes the major features of activities of many other branches of the Department of Agriculture. By far the greater part of the appropriations for the maintenance of the Weather Bureau are expended to provide a Nation-wide service to the public, agriculture, and the industries. Demands for the expansion of this service in almost every community are difficult to resist and absorb practically all the appropriations available. Nevertheless, members of the staff of the Weather Bureau include in their various activities certain particular investigations of the relations of weather to crop development, the inception and generation of storms, investigations of solar radiation, climatology, and the conditions and characteristics of the upper air as revealed by the observations in the free air procured by modern methods that have become available. As already mentioned, some of this research has been interrupted and suspended because of the retirement of the leading officials, and under the provisions of the Economy Act these vacancies have not been filled. Nevertheless, every effort has been made to preserve the nucleus of the research activities of the Bureau, the pursuit of which will be resumed and intensified at the earliest practicable opportunity.

U. S. GOVERNMENT PRINTING OFFICE: 1933



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